# Table of Contents

## Chapter 1: Basic Procedures .............................................. 1
- Elements of an Analysis .............................................. 1
- Understanding the Analysis Environment .......................... 2
  - Viewing Analyses in the Local and Remote Servers .......... 3
  - Locking and Unlocking Analyses .................................. 4
- Adding New Analyses .................................................. 7
- Adding Analyses from the Library ................................... 8
- Importing IMPRINT Analyses ......................................... 10
  - Generic Conversion Variable for IMPRINT 7 imports in IMPRINT Pro . 11
- Opening Analyses ...................................................... 12
- Displaying Analysis Information .................................... 13
- Saving Analyses .......................................................... 13
- Closing Analyses ......................................................... 14
- Closing All Analyses in a Folder ..................................... 15
- Closing All Except Current Analysis ................................. 15
- Copying Analyses ....................................................... 16
- Pasting Analyses .......................................................... 16
- Deleting Analyses .......................................................... 17
- Cutting Analyses ............................................................... 17
- Exporting Analyses ....................................................... 18
- Export All Analyses in a Folder ...................................... 19
- Adding Folders to the Analysis Tree ................................. 20
- Renaming Folders in the Analysis Tree ............................. 20
- Deleting Folders in the Analysis Tree .............................. 21

## Chapter 2: Understanding the IMPRINT Pro Window ................. 23
- IMPRINT Pro Window Overview ....................................... 23
- IMPRINT Pro Window Components .................................... 24
  - Title Bar ................................................................. 24
  - Menu Bar ................................................................. 25
  - Tool Bar ................................................................. 26
  - Accuracy Calculator .................................................... 26
  - Micromodels .............................................................. 29
  - Syntax Helper ............................................................ 31
  - Unit Conversions Calculator .......................................... 32
- Windows ................................................................. 33
  - Analysis Tree Window ................................................ 33
  - Animator ................................................................. 34
  - Event Queue Window .................................................... 38
  - Network Diagram Window .............................................. 39
  - Output Window .......................................................... 39
  - Palette Window .......................................................... 40
- Windows Pane ............................................................ 40
Properties Window ................................................................. 41
Variable Watches Window ..................................................... 41
Status Bar. ............................................................................. 42
Window Configurations ............................................................. 42
Manipulating Windows ............................................................. 45
Floating Windows ..................................................................... 45
Making Windows Dockable ....................................................... 45
Docking Windows .................................................................... 45
Displaying Tab Groups .............................................................. 47
Hiding Windows. ..................................................................... 48
Redisplaying Hidden Windows ................................................ 48
Auto-Hiding Windows .............................................................. 49
Displaying Windows in Auto-Hide Mode ................................. 50
Disabling Auto-Hide Mode ....................................................... 50
Moving Windows ..................................................................... 51
Resizing Windows .................................................................... 51
Changing the Active Window .................................................. 51
Closing Windows ...................................................................... 52

Chapter 3: Overview of Analyses ............................................. 53
Warfighters Module ................................................................. 53
Questions that can be Answered in Warfighter Module. ............ 53
Elements of the Warfighters Module ....................................... 54
Mission Module ....................................................................... 54
Questions that can be Answered in the Mission Module. .......... 55
Elements of the Mission Module .............................................. 55
Warfighters ............................................................................. 57
Tasks ....................................................................................... 57
Task Attributes ....................................................................... 58
Functions ................................................................................ 58
Paths ....................................................................................... 59
Goals ......................................................................................... 59
RI Pairs. ................................................................................ 59
Macros ..................................................................................... 60
Variables ................................................................................ 61
Snapshots ................................................................................ 61
External Events ....................................................................... 61
Charts. ..................................................................................... 62
Cultural Templates ................................................................. 62
Equipment Module ................................................................. 62
Questions that can be answered in the Equipment Module ....... 63
Elements of the Equipment Module ......................................... 63
Custom Performance Moderators ........................................... 64
Force Module .......................................................................... 64
Questions answered by the Force Module ................................ 64
Elements of the Force Module ................................................ 65
## Chapter 4: Warfighter Data

- Displaying Warfighters
- Adding Warfighters
- Displaying Operators
- Displaying Operator Properties
- Changing Operator Specialties
- Operator Workload Management Strategies
  - Entering a Default Management Strategy
- Displaying Maintainers
- Changing Maintainer Specialties
- Displaying Supply and Support Personnel
- Changing Supply and Support Personnel Specialties
- Deleting Warfighters
- Cutting Warfighters
- Copying Warfighters
- Pasting Warfighters

## Chapter 5: Mission Analysis

### Subchapter 5.1 Mission Network Diagram

- Creating a Network Diagram
- Working with Network Objects
  - Adding Network Objects
  - Opening a Network Object
  - Network Object Identification
  - Deleting Network Objects
  - Moving Network Objects
  - Drawing Paths
  - Displaying Path Logic
  - Removing Paths
- Zooming the Network Diagram
- Panning the Network Diagram
- Changing Network Levels
- Editing Text and Objects
- Selecting Text or Objects
- Copying Text and Objects
- Cutting Text and Objects
- Deleting Text and Objects
- Pasting Text and Objects
- Pasting Objects to Mission Model or Analysis
- Copying the Network Diagram as an Image
- Printing the Network Diagram
- Printing the Network Diagram to a PDF File

### Subchapter 5.2 Working With Missions

- Displaying Missions
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editing Function/Capabilities.</td>
<td>268</td>
</tr>
<tr>
<td>Adding Leveraged Capabilities (Goals)</td>
<td>268</td>
</tr>
<tr>
<td>Editing Leveraged Capabilities</td>
<td>269</td>
</tr>
<tr>
<td>Adding Tasks</td>
<td>270</td>
</tr>
<tr>
<td>Task Properties</td>
<td>271</td>
</tr>
<tr>
<td>Editing Tasks</td>
<td>272</td>
</tr>
<tr>
<td>Adding tasks from the Universal Joint Task List (UJTL)</td>
<td>272</td>
</tr>
<tr>
<td>Saving Template Data</td>
<td>276</td>
</tr>
<tr>
<td>Importing MMF Mission Data into IMPRINT Pro</td>
<td>277</td>
</tr>
<tr>
<td>Importing MMF Data as a New Analysis</td>
<td>277</td>
</tr>
<tr>
<td>Importing MMF Data into an Existing Analysis</td>
<td>278</td>
</tr>
<tr>
<td>Subchapter 5.4 Running the Mission</td>
<td>279</td>
</tr>
<tr>
<td>Displaying the Execution Settings</td>
<td>279</td>
</tr>
<tr>
<td>Editing Execution Settings</td>
<td>280</td>
</tr>
<tr>
<td>Execution Setting Properties</td>
<td>280</td>
</tr>
<tr>
<td>Operations Model Execution Properties</td>
<td>280</td>
</tr>
<tr>
<td>Executing the Operations Model</td>
<td>281</td>
</tr>
<tr>
<td>Viewing Operations Model Data During Execution</td>
<td>282</td>
</tr>
<tr>
<td>Network Diagram</td>
<td>284</td>
</tr>
<tr>
<td>Animator Window</td>
<td>284</td>
</tr>
<tr>
<td>Output Tab</td>
<td>285</td>
</tr>
<tr>
<td>Event Queue Tab</td>
<td>289</td>
</tr>
<tr>
<td>Variable Watches Tab</td>
<td>291</td>
</tr>
<tr>
<td>Search and Replace Tab</td>
<td>294</td>
</tr>
<tr>
<td>Checking for Syntax Errors</td>
<td>296</td>
</tr>
<tr>
<td>Controlling Execution</td>
<td>296</td>
</tr>
<tr>
<td>Starting and Resuming Mission Execution</td>
<td>297</td>
</tr>
<tr>
<td>Pausing Mission Execution</td>
<td>297</td>
</tr>
<tr>
<td>Stepping Through Mission Execution</td>
<td>297</td>
</tr>
<tr>
<td>Stopping Mission Execution</td>
<td>298</td>
</tr>
<tr>
<td>Setting the Execution Speed</td>
<td>298</td>
</tr>
<tr>
<td>Subchapter 5.5 Mission and Personnel Reports</td>
<td>299</td>
</tr>
<tr>
<td>Operational Results Reports</td>
<td>301</td>
</tr>
<tr>
<td>Mission Performance</td>
<td>304</td>
</tr>
<tr>
<td>Mission Results by Run</td>
<td>305</td>
</tr>
<tr>
<td>Mission Results by Run Histogram</td>
<td>307</td>
</tr>
<tr>
<td>Function Performance</td>
<td>308</td>
</tr>
<tr>
<td>Task Performance</td>
<td>309</td>
</tr>
<tr>
<td>Task Sequence Chart</td>
<td>312</td>
</tr>
<tr>
<td>Task Failure</td>
<td>312</td>
</tr>
<tr>
<td>Mission Time Drivers</td>
<td>313</td>
</tr>
<tr>
<td>Mission Time Drivers Chart</td>
<td>314</td>
</tr>
<tr>
<td>Operator Workload Summary</td>
<td>315</td>
</tr>
<tr>
<td>Operator Workload Detail</td>
<td>317</td>
</tr>
<tr>
<td>Channel Conflict</td>
<td>320</td>
</tr>
<tr>
<td>Workload Graph</td>
<td>322</td>
</tr>
</tbody>
</table>
Workload Strategy Trace ........................................... 323
Snapshots .............................................................. 325
Stressor Settings ...................................................... 326
Goal Status Report ................................................... 327
Specialty Utilization Report - Operations Model .......... 328
Applying IMPRINT Pro report data to AMCOS ........... 331
Graph Data .............................................................. 334
Personnel Forecast Report ....................................... 335
Cross Analysis Report ............................................. 338

Chapter 6: Equipment Analysis .................................. 343
   Introduction to Equipment Analysis ......................... 343
   Subchapter 6.1 Equipment Data ............................. 345
      Subsystems ...................................................... 345
         Displaying Subsystems ................................ 345
         Adding Subsystems ..................................... 347
         Copying Subsystems .................................... 347
         Cutting Subsystems .................................... 347
         Pasting Subsystems .................................... 348
         Deleting Subsystems .................................. 348
      Components .................................................. 348
         Displaying Components ................................ 348
         Adding Components .................................... 349
         Deleting Components ................................ 349
         Cutting Components .................................... 349
         Copying Components .................................... 350
         Pasting Components .................................... 350
      Repair Tasks ................................................... 351
         Displaying Repair Task Lists ......................... 351
         Adding Repair Tasks .................................... 351
         Displaying Repair Task Data ......................... 353
         Displaying Repair Task Properties ................. 353
         Copying Repair Tasks ................................... 357
         Cutting Repair Tasks .................................... 357
         Pasting Repair Tasks .................................... 358
         Selecting Maintenance Actions ....................... 358
         Deleting Repair Tasks .................................... 359
      Importing Maintenance Task Data from a Template .... 359
         Adding Data to the Maintenance Template ............ 359
         Exporting data from the Maintenance Template .... 361
         Importing Maintenance Template data into IMPRINT Pro .... 362
      Map Maintenance Tasks to Taxons ....................... 364
   Subchapter 6.2 Scenarios ..................................... 366
      Displaying Scenarios ....................................... 366
      Adding Scenarios ........................................... 367
Maintainability Report ......................................................... 413
Maintainability Graph ........................................................ 414
Headcount Frequencies Report ............................................... 415
Manhour Requirements Report ............................................ 416
Manhour Requirements Graph .............................................. 417
Combat Damage Report ....................................................... 418
Logistical Summary Report .................................................. 419
Stressor Settings Report ...................................................... 420
Specialty Utilization Report - Equipment Model ...................... 421
Applying IMPRINT Pro report data to AMCOS ....................... 423

Chapter 7: Custom Performance Moderators ............................. 427

Custom Stressors .................................................................. 427
Displaying a List of Custom Stressors ..................................... 428
Adding Custom Stressors ...................................................... 428
Deleting Custom Stressors .................................................... 429
Cutting Custom Stressors ..................................................... 429
Copying Custom Stressors ..................................................... 429
Pasting Custom Stressors ..................................................... 430
Displaying the Custom Stressors Dialog Box ......................... 430
Adding Custom Stressor Levels ............................................. 431
Deleting Stressor Levels ....................................................... 432
Defining Time and Accuracy ................................................ 432
Creating Algorithms for Accuracy and Time ......................... 433
  Creating the Algorithm Expression .................................... 433
  Checking Algorithm Syntax .............................................. 436
  Testing Accuracy and Time Algorithms ............................. 437
Applying Custom Stressors ................................................ 439
Viewing Custom Stressor Results ......................................... 439

Custom Training Moderators ............................................... 440
Displaying a List of Custom Training Moderators .................... 440
Adding Custom Training Moderators ..................................... 440
Deleting Custom Training Moderators .................................. 441
Cutting Custom Training Moderators .................................... 441
Copying Custom Training Moderators .................................. 442
Pasting Custom Training Moderators .................................... 442
Displaying the Custom Training Moderators Dialog Box ........... 442
Adding Custom Training Levels .......................................... 443
Deleting Custom Training Levels ........................................ 443
Defining Time and Accuracy ............................................... 444
Creating Algorithms for Accuracy and Time ......................... 444
  Creating the Algorithm Expression .................................... 444
  Checking Algorithm Syntax .............................................. 447
  Testing Accuracy and Time Algorithms ............................. 448
Using Custom Training Moderator Templates ....................... 450
Applying Custom Training Moderators ................................ 452
**Chapter 8: Force Analysis**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Force Analysis</td>
<td>453</td>
</tr>
<tr>
<td>Force Analysis Data</td>
<td>455</td>
</tr>
<tr>
<td>Force Units</td>
<td>456</td>
</tr>
<tr>
<td>Displaying Force Units</td>
<td>456</td>
</tr>
<tr>
<td>Adding Force Units</td>
<td>456</td>
</tr>
<tr>
<td>Displaying Force Unit Properties</td>
<td>457</td>
</tr>
<tr>
<td>Schedules</td>
<td>457</td>
</tr>
<tr>
<td>Displaying a List of Schedules</td>
<td>459</td>
</tr>
<tr>
<td>Adding a Schedule</td>
<td>459</td>
</tr>
<tr>
<td>Deleting a Schedule</td>
<td>460</td>
</tr>
<tr>
<td>Force Activities</td>
<td>460</td>
</tr>
<tr>
<td>Displaying Activity Categories</td>
<td>461</td>
</tr>
<tr>
<td>Planned Activities</td>
<td>461</td>
</tr>
<tr>
<td>Displaying Planned Activities</td>
<td>462</td>
</tr>
<tr>
<td>Adding a Planned Activity</td>
<td>462</td>
</tr>
<tr>
<td>Displaying and Editing Planned Activity Properties</td>
<td>463</td>
</tr>
<tr>
<td>Deleting a Planned Activity</td>
<td>464</td>
</tr>
<tr>
<td>Adding Planned Activities to a Schedule</td>
<td>464</td>
</tr>
<tr>
<td>Removing a Scheduled Activity</td>
<td>467</td>
</tr>
<tr>
<td>Unplanned Activities</td>
<td>468</td>
</tr>
<tr>
<td>Viewing Unplanned Activities</td>
<td>468</td>
</tr>
<tr>
<td>Adding an Unplanned Activity</td>
<td>469</td>
</tr>
<tr>
<td>Displaying and Editing Properties of an Unplanned Activity</td>
<td>469</td>
</tr>
<tr>
<td>Deleting an Unplanned Activity</td>
<td>472</td>
</tr>
<tr>
<td>Activities Trump Matrix</td>
<td>472</td>
</tr>
<tr>
<td>Displaying the Activities Trump Matrix</td>
<td>473</td>
</tr>
<tr>
<td>Changing the Trumping Activity</td>
<td>473</td>
</tr>
<tr>
<td>Jobs</td>
<td>474</td>
</tr>
<tr>
<td>Displaying Jobs</td>
<td>475</td>
</tr>
<tr>
<td>Adding Jobs</td>
<td>475</td>
</tr>
<tr>
<td>Displaying and Editing Job Properties</td>
<td>475</td>
</tr>
<tr>
<td>Running the Force Analysis Model</td>
<td>477</td>
</tr>
<tr>
<td>Setting the Force Model Execution Settings</td>
<td>477</td>
</tr>
<tr>
<td>Executing the Forces Model</td>
<td>478</td>
</tr>
<tr>
<td>Viewing Force Analysis Reports</td>
<td>479</td>
</tr>
<tr>
<td>Activity Detail Report</td>
<td>480</td>
</tr>
<tr>
<td>Total Time by Job Report</td>
<td>481</td>
</tr>
<tr>
<td>Total Time by Schedule Report</td>
<td>484</td>
</tr>
<tr>
<td>Time Total by Individual Job</td>
<td>486</td>
</tr>
<tr>
<td>Unplanned Activity Status Report</td>
<td>487</td>
</tr>
<tr>
<td>Specialty Utilization Report - Forces Model</td>
<td>489</td>
</tr>
<tr>
<td>Applying IMPRINT Pro report data to AMCOS</td>
<td>491</td>
</tr>
</tbody>
</table>
### Chapter 9: Plugins
- Using Plugins .......................................................... 497
- Creating Plugins ...................................................... 498
- Creating an IMPRINT Pro Plug-In ...................... 498
- Setting Up the Project .............................................. 500
- Writing the Code for Plugins .......................... 502
- Building the Plugin ................................................. 507
- Displaying Plugins .................................................. 507
  - Viewing the Parts of a Plugin in the Tree .................. 508
- Adding Hover Text to a Plugin ......................... 510

### Appendix A: Technical Description of Stressor Implementation .... 513

### Appendix B: Human Performance Micromodels ........... 529
- Perceptual Micromodels ........................................... 529
- Motor Micromodels ............................................... 530
- Cognitive Micromodels ......................................... 534
- Special Micromodels ............................................. 536

### Index ................................................................. 537

### Glossary ........................................................... 553
The Improved Performance Research Integration Tool (IMPRINT) was developed for the Army Research Laboratory (ARL) Human Research and Engineering Directorate (HRED). This manual describes the professional version of IMPRINT, named IMPRINT Pro. IMPRINT Pro is government-owned and consists of a set of automated aids to assist analysts in conducting human performance analyses. IMPRINT Pro provides the means for estimating manpower, personnel, and training (MPT) requirements and constraints for new weapon systems very early in the acquisition process.

Chapter 1: Basic Procedures

Basic IMPRINT Pro procedures include creating, opening, and saving, cutting, copying, pasting, closing, deleting and exporting analyses. They also include adding and deleting the folders which contain them.

Before working with any new analyses, however, it is recommended that you first check your settings for your local server where your analyses will be saved. You may also optionally set your system up to work with a remote server in order to access files from a networked computer running the same version of IMPRINT Pro.

Elements of an Analysis

An IMPRINT analysis contains the following elements:

- **Warfighters.** The Warfighters in your analysis are the different types of people that are required by your Operational Mission models or Maintenance models. Warfighters are broken down into Operators, Maintainers and Supply and Support Personnel.
Missions. The Missions in your analysis are models which represent processes you are attempting to simulate. Each model is comprised of a series of tasks, functions and goals which are connected as a network. When you run a mission model, the model calculates task performance times, implements appropriate workload strategies during operator overload, evaluates accuracy to determine task failure, implements failure consequences, and collects results of task, function and mission performance times.

Equipment. The Equipment node contains all scenarios, segments, subsystems, components and repair tasks required by a maintenance model. In turn, this maintenance model simulates the flow of systems into mission segments and the performance of maintenance actions to estimate maintenance manhours for your system.

User Stressors. The User Stressors node contains all user stressors designed for the analysis. Each user stressor, when implemented, is designed to impact task time and/or accuracy when the model runs.

Forces. The Forces node contains all Force Units included in your analysis. Each Force Unit is comprised of a set of activities (planned and unplanned) and jobs. This information, when modeled, helps predict the manpower needed to perform the routine and unplanned work done by a force unit.

By default, all analyses in your tree contain these same five levels of information. You must, however, provide the data in each of the areas as required by your model.

When you save, cut, copy, paste, delete, import and export an analysis, all areas listed above for the analysis you have selected are included.

Understanding the Analysis Environment

The highest level nodes in the Analysis Tree are the Local Server node and the Remote Server node. These nodes represent the local server directory and the remote server directory where you may access and store your analyses.

When starting up IMPRINT Pro, the server nodes immediately appear in the Analysis Tree.
Viewing Analyses in the Local and Remote Servers

Analyses may be added to and stored in folders you create in the Local Server folder and Remote Server folder. For more information on setting up the remote server environment, see IMPRINT Pro User Guide Volume 2: Basic Procedures, Appendix D.

To view analyses in the local and remote server environments:

1. Click the plus “+” sign next to the Local Server node.

   A list of folders containing your analyses appears.

2. Click the plus “+” sign next to a folder.

   A list of analyses within the folder appears.

✓ Note:
   By default, IMPRINT Pro includes a folder called “Analyses.” For creating additional folders in the tree see “Adding Folders to the Analysis Tree” on page 20.
Locking and Unlocking Analyses

When using the remote server option in IMPRINT Pro, access to analyses is shared between two or more users. This provides the benefit of allowing several users access to the same analysis without having to export and import the analysis from machine to machine.

To prevent two or more users from accessing the same analysis at the same time and potentially overwriting each other’s changes, you may first lock the analysis. The lock option allows you to open, modify, run and save the analysis as you choose while allowing other users limited privileges of viewing a copy of the analysis in its last saved state. When you have completed and saved your changes to the analysis, you may then unlock the analysis for other users to be able to access and modify your updated file as required.

To lock an analysis:

1. Right-click the desired analysis in the Analysis Tree.

   From the shortcut menu which appears, select the Lock Analysis option.
2. The blue lock symbol appears next to the analysis name in the tree.

To unlock an analysis:

Right-click the desired locked analysis in the Analysis Tree.

From the shortcut menu which appears, select the **Unlock Analysis** option.
The blue lock symbol disappears from the analysis name in the tree, and the analysis is once again fully accessible by all other remote users.

**Note:**
Prior to unlocking the model, you will be prompted to save your analysis if your model has any changes which have not been saved.

The following conditions should also be considered when locking and unlocking analyses:

- If another user has a lock on the model, a message appears both before the model run and before attempting to run reports that reports are unavailable. This is because you do not have the lock thus you cannot save model run data to the database for the reports to be able to utilize.

- If you have the lock and choose to unlock the analysis, every time you run the model the analysis will be re-locked. This is because IMPRINT Pro needs to ensure that data from the model run can be saved to the database, which requires a lock.

- Closing the analysis (using the actual Close Analysis shortcut option to do this) will result in the lock being released.
Collapsing the analysis in the tree does not result in the lock being released.

Adding New Analyses

To add an analysis:

1. In the Analysis Tree, right-click the Analyses folder (or other folder) and select New Analysis from the shortcut menu that displays.

OR

From the File menu, select the New Analysis option. In the submenu to the right, select the folder in which the new analysis should appear. If no folders appear, you must first create a new folder in the tree and then retry this option.

The new analysis displays under the selected folder in the Analysis Tree and is selected automatically. The Properties window updates to display properties of this analysis.

2. In the Properties window, type in a new name and version in the Analysis Name and Analysis Version fields, if desired.

3. Click outside the Properties window.

The name and/or version of your analysis updates in the tree.

Note:
A new analysis is not saved to your database until you use the Save or Save As command, or until you run the model. For more information see “Saving Analyses” on page 13.
Adding Analyses from the Library

IMPRINT Pro contains libraries of data on numerous currently fielded Army systems. The purpose of these data is to provide you with a starting point for conducting your analysis. For example, if you want to conduct an analysis in support of a new tank, you could load the mission models for the M1 tank for reference, and then modify these existing missions to reflect the missions of your new tank.

To add an analysis from the library:

1. In the Analysis Tree, right-click the Analyses folder (or other folder) and select Library Analysis from the shortcut menu that displays.

   OR

   From the File menu, select the Library Analysis option. In the submenu to the right, select the folder in which the new library analysis should appear. If no folders appear, you must first create a new folder in the tree and then retry this option.

   A list of all the weapon systems for which IMPRINT Pro contains data displays.

2. Select the system that is closest to your new system, and then click OK.

   This will cause the library data for the selected system to be copied into your analysis database. The mission, Warfighters, and equipment data associated with that library system will be available to you in subsequent dialog boxes.

   The library systems available in IMPRINT Pro include those in the following table.
<table>
<thead>
<tr>
<th>Mission Area</th>
<th>System Type</th>
<th>System Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Defense</td>
<td>Air Defense Mobile Gun</td>
<td>M163VULC</td>
</tr>
<tr>
<td>Air Defense</td>
<td>HIMAD</td>
<td>Patriot FP</td>
</tr>
<tr>
<td>Air Defense</td>
<td>Man-portable Air Defense System</td>
<td>STINGER</td>
</tr>
<tr>
<td>Aviation</td>
<td>Attack Helicopter</td>
<td>AH-64A</td>
</tr>
<tr>
<td>Aviation</td>
<td>Cargo Helicopter</td>
<td>CH 47D</td>
</tr>
<tr>
<td>Aviation</td>
<td>Scout Helicopter</td>
<td>OH 58D</td>
</tr>
<tr>
<td>Aviation</td>
<td>Utility Helicopter</td>
<td>UH-60A</td>
</tr>
<tr>
<td>Close Combat Heavy</td>
<td>Cavalry Fighting Vehicle</td>
<td>M3 BRADLEY</td>
</tr>
<tr>
<td>Close Combat Heavy</td>
<td>Tank</td>
<td>M1 ABRAMS</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Anti-Tank Vehicle</td>
<td>M901 ITV</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Automatic Weapon</td>
<td>M249 SAW</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Grenade Launcher</td>
<td>M203</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Infantry Fighting Vehicle</td>
<td>M2 Bradley</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Man-portable Anti-Tank Weapon</td>
<td>DRAGON</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Man-portable Indirect Fire Weapon</td>
<td>M252 81MM</td>
</tr>
<tr>
<td>Close Combat Light</td>
<td>Rifle</td>
<td>M16A1</td>
</tr>
<tr>
<td>Combat Service Support</td>
<td>Heavy Truck</td>
<td>M977 HEMTT</td>
</tr>
<tr>
<td>Combat Service Support</td>
<td>Light Truck</td>
<td>M998 HMMWV</td>
</tr>
<tr>
<td>Fire Support</td>
<td>Medium Range Missile Artillery</td>
<td>LANCE</td>
</tr>
<tr>
<td>Fire Support</td>
<td>Rocket Field Artillery System</td>
<td>MLRS</td>
</tr>
</tbody>
</table>
Importing IMPRINT Analyses

IMPRINT Pro is compatible with analyses created in previous versions, such as IMPRINT 7 and IMPRINT Standard 8. Users of version 5 or 6 must upgrade to version 7, import these 5/6 analyses into IMPRINT 7 and then export them from IMPRINT 7 to a Pro-compatible format (.7xp). IMPRINT Standard 8 users must export their analyses from IMPRINT Standard 8 to the Pro-compatible format (.8xp). While these analyses are being imported into IMPRINT Pro, they will automatically be converted to the new Pro format (.pro) and will display in the IMPRINT Pro window. The conversion may take a few minutes depending on the complexity of the analysis.

✓ Note:
  Once converted, IMPRINT 7 and IMPRINT Standard 8 files may not be converted back to their previous format. Therefore backups of these analyses in their original format should first be made before any importing/converting occurs if opening these analyses in previous versions is still required.

An IMPRINT Pro analysis and all of its data can be imported into your list of existing analyses from another folder or drive on your computer, or from another computer on a network.

To import an analysis:

1. In the Analysis Tree, right-click the Analyses folder (or other folder), and then select Import Analysis... from the shortcut menu that displays.

   OR

   From the File menu, select the Import Analysis... option. In the submenu to the right, select the folder in which the imported analysis should appear. If no folders appear, you must first create a new folder in the tree and then retry this option.

   The Import IMPRINT Analysis dialog box displays.
2. Click the drop-down arrow to the right of the **Files of Type** box.

3. Select one of the following:
   - IMPRINT Pro files
   - IMPRINT Standard files
   - IMPRINT 7 imports
   - All IMPRINT files

4. Locate and select the desired analysis to import.

5. Click **Open**.

The newly added analysis appears in the tree, highlighted to indicate it is the currently selected analysis.

**Generic Conversion Variable for IMPRINT 7 imports in IMPRINT Pro**

C# (the language used for code in IMPRINT PRO) is a strongly-typed language. All variables and returned values must be of a declared type (int, bool, string, float). When importing code from IMPRINT 7, it is not always possible to determine which type a code expression is meant to have. In those cases, in order to create legal C# code, the expression is assigned to `GlobalConversionVariable`, a special internal variable that can be converted to the actual type of the expression.

For example, the following code from IMPRINT 7:

```csharp
1;
```

Could be imported into IMPRINT Pro as either:

```csharp
return 1;  // (an integer)
```

or:

```csharp
return true;  // (a boolean value)
```

It is not clear which meaning was intended by the IMPRINT 7 modeler, so the import process would generate the following code:

```csharp
GlobalConversionVariable = 1;

return GlobalConversionVariable;
```
If (at run-time) the code were in a context that expected to have a true/false value, `GlobalConversionVariable` would return true; if an integer were required, it would return 1.

![Note: Removing and/or altering the GenericConversionVariable expression(s) added to your model by IMPRINT Pro may result in model runtime errors.]

---

**Opening Analyses**

When you open an analysis, you are opening the data tables in your database which correspond to your analysis. This will allow you to modify and/or run the models in your analysis in IMPRINT Pro. All analyses immediately available for opening display in the folders in the Analysis Tree. Any analysis you wish to open which does not appear in the tree must first be imported. You can open any existing analysis in a few simple steps.

**To open an analysis:**

1. In the Analysis Tree, click the + adjacent to the node of the folder containing the analysis you wish to open.

   The folder expands, and a list of analyses display below, sorted by name.

2. Click once on any analysis to select and open it.

   The analysis is now selected, and the contents of the analysis are loaded from the database. The name of the analysis displays in the main window and the Properties window. Its listing is highlighted in the tree.

3. To see the contents of the opened analysis, click the + adjacent to the analysis name node.

   A list of nodes containing analysis data appear below. Nodes include *Warfighters, Missions, Equipment, User Stressors* and *Forces.*
Displaying Analysis Information

To display analysis information:

In the Analysis Tree, double-click the analysis name. The analysis information tab appears in the main window.

This same information appears in the Properties window.

Saving Analyses

As you work on an analysis, save frequently—do not wait until you finish working. By saving the analysis frequently, you reduce the amount of work lost in the event of a power failure or other unforeseen problem.

To save an analysis:

Do one of the following:

- From the File menu, select Save.
• On the tool bar, click the Save button.
• Press the shortcut keys Ctrl+S.

IMPRINT Pro saves the model to the database, overwriting any existing model with the same name.

Closing Analyses

Having more than one analysis open at a time can be convenient when copying and pasting data from one analysis to another. As a consequence, however, having more than one analysis open at a time can use large amounts of memory, leading to a lag in system performance while running a model. To improve system performance, close any unnecessary analyses in the tree that you are no longer using to free up system memory. Closing is not necessary prior to saving or exporting analyses, nor is it necessary prior to closing the IMPRINT Pro application.

To close an analysis:

1. In the Analysis Tree, right-click the analysis you wish to close folder, and then select Close Analysis... from the shortcut menu that displays.

   OR

   Click the desired analysis in the tree once to select it. From the File menu, select the Close Current Analysis... option.

2. You may be prompted to save changes to your analysis prior to closing. At the prompt, choose Yes to save changes and close or No to discard changes and close. Cancelling out of this option cancels the process of closing your analysis.

The desired analysis closes.
Chapter 1: Basic Procedures

Closing All Analyses in a Folder

Similar to the Close Analysis option, the Close All Analyses in Folder option helps to close unnecessary analyses that you are no longer using which can lead to improved system performance when running models. When selecting this option, however, it should be noted that all currently open analyses in the folder you select are closed. You may be prompted to save each analysis before it closes. Closing is not necessary prior to saving or exporting analyses, nor is it necessary prior to closing the IMPRINT Pro application.

To close all analyses in a select folder:

1. In the Analysis Tree, right-click the folder whose entire contents you wish to close, and then select Close All Analyses in Folder option from the shortcut menu that displays.

2. You may be prompted to save changes to your analysis prior to closing. At the prompt, choose Yes to save changes and close or No to discard changes and close. Cancelling out of this option cancels the process of closing your analysis.

The desired folder and all the analyses it contains close.

Closing All Except Current Analysis

Similar to the Close Analysis option, the Close All Except Current Analysis option helps to close unnecessary analyses that you are no longer using which can lead to improved system performance when running models. When selecting this option, however, it should be noted that all currently open analyses in all folders of the analysis tree, with the exception of the currently-selected analysis in the tree, are closed. You may be prompted to save each analysis before it closes. Closing is not necessary prior to saving or exporting analyses, nor is it necessary prior to closing the IMPRINT Pro application.

To close all analyses except the current analysis:

1. In the Analysis Tree, select the analysis you wish to keep open by clicking it.
2. From the **File** menu, select the **Close All Except Current Analysis** option.

3. You may be prompted to save changes to your analysis prior to closing. At the prompt, choose **Yes** to save changes and close or **No** to discard changes and close. Cancelling out of this option cancels the process of closing your analysis.

All analyses other than the currently-selected analysis close.

### Copying Analyses

You can copy an analysis from one folder to another in the Analysis Tree.

**To copy an analysis:**

1. In the Analysis Tree, right-click the analysis you want to copy and select **Copy Analysis**.

2. Right-click the folder to which the analysis should be copied and select **Paste Analysis** from the menu that displays.

   The analysis is copied to the folder with the same name and version number, incremented by one. For more information on folders see “**Adding Folders to the Analysis Tree**” on page 20.

### Pasting Analyses

You can copy and paste an analysis from an existing folder to the new folder.

**To paste an analysis:**

1. Select the analysis you want to paste in to another folder.

2. Right-click the analysis and select **Copy Analysis** or **Cut Analysis** from the menu that displays.

3. Right-click the folder to which you want to paste the analysis.
4. From the shortcut menu that displays, select **Paste Analysis**.

   The analysis is copied from the existing folder and pasted into the new folder.

---

**Deleting Analyses**

The delete command will remove the analysis and all its associated data from the Analysis Tree, and consequently from the database. Once you have removed the analysis, you cannot undo it.

*To delete an analysis:*

1. Right-click the analysis you want to delete.
2. Select **Delete Analysis** from the menu that displays.

---

**Cutting Analyses**

When you cut an analysis, you remove the analysis from the folder it was in but not from the IMPRINT Pro database. It can then be added to another folder using the Paste command.

*To cut an analysis:*

1. Select the analysis to cut.
2. Right-click the analysis and select **Cut Analysis** from the menu that displays.
3. Right-click the folder to which the analysis should be pasted.
4. Select **Paste Analysis**.

   The analysis is cut from the existing folder and pasted into the new folder. When you perform the Cut command on an analysis, the analysis will display in red until you paste it to a new location.
Exporting Analyses

The process of exporting an analysis allows you to combine all data from that analysis (stored as numerous tables in a database on your system) and save it to a single file which may then be distributed to other systems running a compatible version of IMPRINT Pro. These systems must then import this file to add the analysis to their databases.

Exported analyses are also a convenient way to back up your data - in the event you must reinstall IMPRINT Pro, any analysis you saved as an export can immediately be brought back into your database by using the Import Analysis option.

To export an IMPRINT Pro analysis:

1. Right-click the analysis to export and select Export Analysis from the menu that displays.

   The Export IMPRINT Pro Analysis dialog box displays.

2. At the top of the window, click the drop-down arrow to the right of the Save in box, and select the location where you want to export the analysis.
3. The **File Name** box automatically lists the name of the analysis you have selected to export. By default the exported file will take on the same name as the analysis, making it easy to recognize your analysis for import later on. You may, however, modify the name as desired by typing in the new name in the **File Name** field.

4. Click **Save**.

The analysis is saved as a single file to the specified location with the extension `.pro`.

---

**Export All Analyses in a Folder**

Similar to the **Export Analysis** option, the **Export All Analyses in Folder** option helps to export analyses from your database so that they may be shared with other systems having a compatible version of IMPRINT Pro. When selecting this option, however, it should be noted that all analyses in the folder you select are automatically exported to the location you specify, and you will not have the option to modify the names of your exported file as you do with the Export Analysis option.

**To export all analyses in a select folder:**

1. In the Analysis Tree, right-click the folder whose entire contents you wish to close, and then select **Export All Analyses in Folder** option from the shortcut menu that displays.

   The **Browse for Folder** dialog appears.

2. Locate and select the folder to which you wish to save your exported analyses.

3. Click **OK**.

All analyses in the selected folder export as unique `.pro` files in the location specified.
Adding Folders to the Analysis Tree

You can organize analyses much like you organize files into folders on your computer by adding folders to the Analysis Tree. By default, IMPRINT Pro includes a directory in the Analysis Tree under the Local Server folder called Analyses, under which you may save your analyses. You may, however, create new folders in the tree as desired.

To add a folder to the Analysis Tree:

Do one of the following:

- From the File menu, select Add Analysis Folder.
- Right-click anywhere in the Analysis Tree, and select Add Analysis Folder.

A new folder is added to the Analysis Tree and automatically selected.

Renaming Folders in the Analysis Tree

To rename a folder in the Analysis Tree:

1. Select the folder to rename in the Analysis Tree.
   
   Information for this folder displays in the Properties window.

2. In the Folder Name box, enter the new folder name.

3. Click the mouse outside the folder name field.

   The folder updates to the new name.
Deleting Folders in the Analysis Tree

The Delete command removes the folder and all its contents from the Analysis Tree and the database.

To delete a folder:

Do one of the following:

- Right-click the folder you want to delete, and select Delete Folder from the menu that displays.
- Select the folder you want to delete, and click the Delete button on the keyboard.

A dialog box displays, asking you to confirm deletion of this folder and all its contents. To confirm Delete, click the Ok button.

The folder is deleted from the Analysis Tree. All analyses previously contained by the folder are also deleted from the Analysis Tree and the database.
Chapter 2: Understanding the IMPRINT Pro Window

IMPRINT Pro uses a modified form of the MDI (Multiple Document Interface) made available by Microsoft .NET Framework. MDI provides a parent container window that contains several other different window panes. This configuration allows you to reposition windows into logical working groups and to temporarily hide windows that you are not using. The IMPRINT Pro window is highly configurable, and changes to the configuration are saved when you save an analysis.

IMPRINT Pro Window Overview

The default configuration for the IMPRINT Pro window consists of a container window with a title bar, menu bar, tool bar, and status bar. Within this container, the following elements exist as separate window panes: Analysis Tree, Network Diagram, Properties, Palette, Windows, Variable Watches, Event Queue, Search, and Output.

You can move, resize, hide, and dock all of the windows. You may want to use different configurations during different stages of analysis development. You may save up to three customized layouts at any one time that you may switch at the click of a button. Customized layouts always save in their last-modified state until they are once again modified or reset to the default IMPRINT Pro configurations.

The following illustration shows the components of the IMPRINT Pro window. Each of these components are described in greater detail in the remaining sections of this chapter.
IMPRINT Pro Window Components

This section describes the window components in the main IMPRINT Pro window. For details on resizing, moving, hiding, and docking the windows, see "Manipulating Windows" on page 45.

Title Bar

The title bar displays at the very top of the IMPRINT Pro window. It contains the name and version of the currently open mission or scenario and the analysis to which it belongs.
Menu Bar

The menu bar displays below the title bar at the top of the IMPRINT Pro window and contains the **File**, **Edit**, **View**, **Reports**, **Tools**, **Utilities**, and **Help** menus. After opening your mission, the expanded menu will display the additional options of **Moderators** and **Execution**.

- **File.** The File menu includes basic commands such as Add Analysis Folder, Save Analysis, Save As, Print Diagram and Exit.

- **Edit.** The Edit menu includes basic edit commands such as Copy, Copy Diagram as Image, Cut, Paste, Clear Output and Preferences.

- **View.** The View menu contains commands to zoom the display, display different windows, and reset the screen layout.

- **Moderators.** The Moderators menu includes commands for mapping workload or maintenance to taxons, setting performance moderators and reviewing the affects of those moderators on task times and accuracies.

- **Execution.** The Execution menu includes commands for controlling execution, such as Begin, Step, and Halt and Abort Simulation. It also includes Check for Errors, an option to run a syntax check on your model, and several options for adjusting model execution settings (execution speed, number of runs, simulation speed and more).

- **Reports.** The Reports menu includes many types of detailed reports that can be generated to display the results of your model.

- **Tools.** The Tools menu includes commands to display the Accuracy Calculator, Micromodels, Syntax Helper, and Unit Conversions windows.

- **Utilities.** The Utilities menu includes commands for enabling Display Trace, Network Animation and Update Comment Variables. Commands for controlling the network nodes in the diagram (Alignment, Snap to Grid) also appear in this menu. You may also view the entire model in an html format using the View Model as HTML option.

- **Help.** The Help menu contains the commands About to display version information and Help to open online help.
Tool Bar

The IMPRINT Pro Tool Bar displays below the menu bar and provides access to commonly used commands. When you move the pointer over each button, a tooltip displays the command and the associated shortcut key if available.

By default the Tool Bar is divided into four sections, split by small notches in the bottom of the Tool Bar:

- **The File System** section includes buttons to open, save, and cut, copy and paste.

- **The Execution** section includes buttons to use in mission simulation, such as checking for errors, starting, pausing, stepping, and halting mission execution, and controlling simulation speed in real time mode.

- **The Layout** section includes buttons for Custom Layout 1, Custom Layout 2, and Custom Layout 3.

- **The Tools** section contains the Accuracy Calculator and Unit Conversions tool. It also contains the Micromodels tool for accessing human performance models and Syntax Helper for accessing sample code formats which may be used in effects, macros and other code windows.

Accuracy Calculator

The Accuracy Calculator dialog box lets you enter three of the four data elements that are needed to specify task accuracy (accuracy standard, accuracy mean, accuracy standard deviation, and probability of success), so that it can calculate and display the fourth data item. In addition, it will draw the normal distribution and show the area under the curve that is used to calculate the probability of success.
In IMPRINT Pro, the likelihood that a task will be performed accurately is determined by an estimated mean and standard deviation that work together with the accuracy measure (for example, “percent steps correct”). When the model runs, IMPRINT Pro pulls a number from a normal distribution created with the mean and standard deviation you enter. This is compared to the accuracy standard to determine whether the task succeeded or failed its accuracy on each occurrence. If the number pulled is higher than the accuracy standard and the accuracy measure determines that higher equates with more accurate (e.g., percent steps correct), then the task is considered a success.

For example, you might say that on the average when performing this task the operators get 90 percent of the steps correct, or for another tasks they are within 10 mils of the correct azimuth. Under the first option, you will also specify the standard deviation, which is a measure of the worst and best the task is likely to be performed. An easy rule of thumb for specifying the standard deviation is to compute the difference between the worst and best performance and divide it by 6. For example, if the worst performance is 40% steps correct and the best is 100%, then an estimate for the standard deviation would be 10% \( \left(\frac{100 - 40}{6}\right) = 10 \).

We realize that it is often difficult for users to think of accuracy in these terms, and that it is often easier to think of it in terms of the probability of success. To accommodate this fact, we have provided a calculator that you can use to calculate the probability of success from the information you have entered. When you select the Accuracy Calculator, IMPRINT Pro uses your accuracy mean and accuracy standard deviation, as well as the accuracy standard to calculate the probability of success. This is actually
calculated using standard statistical procedures that compute the area under a Normal statistical curve. IMPRINT Pro is also careful to evaluate your accuracy measure to determine whether “bigger values” are better (for example, percent steps correct), or “smaller values” are better (for example, mils from desired). For more information, please refer to a statistics textbook.

We have also provided access the Accuracy Calculator dialog box that lets you enter three of the four data elements that are needed to specify accuracy (that is, accuracy standard, accuracy mean, accuracy standard deviation, and probability of success), and it will calculate and display the fourth data item. In addition, it will draw the normal distribution and show the area under the curve that is used to calculate the probability of success.

**To use the Accuracy Calculator:**

1. In the Network Diagram or the Analysis tree, select a task for which accuracy will be calculated.

   ✓ **Note:**
   By choosing a task first before opening the Accuracy Calculator window, the Accuracy Calculator window, once opened, will then automatically provide an option for applying your calculated value to this selected task.

2. From the **Tools** menu click **Accuracy Calculator**.

   The Accuracy Calculator window appears.

3. Choose a description of measure from the Measure drop-down list which best describes accuracy for your task.

4. Click the radio button of the value you wish to calculate. Values include Accuracy Requirement, Probability of Success, Mean Accuracy and Standard Deviation.

5. Enter values in the remaining three fields.

6. Click the **Calculate** button next to the choice you selected.

   Your calculated value appears in the adjacent field.

7. Click the **Apply to Selected Task** button if you wish to replace your task’s existing value with the newly calculated value.
Micromodels

The Micromodels tool is included in IMPRINT Pro to help you access a set of micromodels of human performance that have been gathered from psychological research literature. Detailed Micromodels help construct an overall task time. These micromodels provide time estimates for performing basic activities, such as visual scanning, moving a hand from one position to another, or pushing a button. By stringing together basic activities, an overall task time (or mean task time) can be estimated.

Many of these micromodels are just constant values, for example the Eye Movement Time (target is in the field) micromodel which has an algorithm value of 0.1. Other micromodels include prompts for you to enter pertinent data, for example the Hand Movement micromodel, which requires entering a distance to target and target size. In either case the Micromodels window then calculates an adjustment to the existing mean task time which you can then choose to apply to your task.

When you choose a micromodel you will be prompted to enter any parameter information that is needed. The reference for each micromodel is included in the dialog box, so that you can refer to the literature if you have specific questions about the assumptions behind each micromodel. A list of all the micromodels and their references is provided in Appendix A of this User Guide.

To apply a Micromodel:

1. From the Tools menu click Micromodels. The Micromodels window appears.

2. In the Micromodel Name field click the drop-down arrow to display a list of available micromodels. Click the desired micromodel to select it. The micromodel name displays in the Micromodel Name field, and its algorithm and reference display in the fields below.

3. Enter the necessary parameters in the P1 - P4 fields if required by the selected micromodel.

4. Click the Calculate button. The adjustment appears in the Calculated Adjustment box in the Task section of the dialog.
5. Select the manner in which the adjustment should be applied to your current mean task time by clicking the radio button next to your choice. The Calculated Adjustment may be added to, subtracted from or replace the current mean task time. By default, the option None is selected.

By clicking the radio button of your selection, the modified mean task time (as it would be if you applied this adjustment) appears in the Adjusted Mean Time field.

6. Click the Apply to Task button.
Syntax Helper

The Syntax helper is an interactive tool that helps you see the acceptable syntax for any expressions you might enter in IMPRINT Pro. Use the syntax help if you are uncertain of the format of any expression. You can copy and paste the sample code from the helper into your beginning effects, ending effects or advanced mean time expressions and then modify the generic expressions to suit the needs of your model. Use the sample code for more guidance.

**To use the Syntax Helper:**

1. From the **Tools** menu click **Syntax Helper**.

   The Syntax Helper window appears.

2. In the list on the left, click the desired code example under the Loops section or the Conditional Statements section. For example, click the “Do” listing to see sample code for a do-while expression.

   Sample code appears in the window on the right. You may copy and paste code from this window into any code window in IMPRINT Pro.

3. Replace all parts of your pasted code containing “<expression>” with code that achieves your goal.

   ![Syntax Helper Window](image)

   Note: copy and paste sample code into your model

**Unit Conversions Calculator**

The Unit Conversions tool is a calculator which converts a value in a particular unit of measure to its equivalent value in a different unit of measure.
To use the Unit Conversion tool:

1. From the Tools menu click Unit Conversions.
   
   The Unit Conversions window appears.

2. Click the Time tab or Distance tab, depending on the type of units you wish to convert.

3. Enter the value to be converted in the Original Value field.

4. Select the desired “from” and “to” units by clicking the drop-down arrows in each field and selecting the desired units from the lists provided.

   The Result field automatically updates with the converted value.

Windows

Select Windows from the View menu to display the windows described below.

Analysis Tree Window

The Analysis Tree View window displays a hierarchical list of the analyses, automatically sorted by name. Listed under each individual analysis are Warfighters, Missions, Equipment, and User Stressors. The last item in the tree is the Plugins node which lists all user-defined plugins that are currently recognized by IMPRINT Pro.

To expand a component in the Analysis Tree, click the + adjacent to the item. To collapse a component, click the - adjacent to the item.
Animator

The Animator window displays a two dimensional graphical depiction of the model as it executes. For an operational mission, the Animator window displays bar charts of workload by operator which continually update as the model runs. Information displayed includes Maximum Workload, Number of Active Tasks and Active Workload Strategy. For a maintenance model, the Animator window displays Queue Data, Combat Data, Shift Manning, Maintenance Summary, Reliability and Availability, Clock, and Day data. At the bottom of the animation a graphic of a tank shows the progress of the model along a Percent of Time Elapsed bar.

Each time you begin a simulation, data from the previous run will clear and the simulation will begin to display new information. If you halt the model, a dialog will display that tells you no reports will be available.

**To view animation during a model run:**

1. Display the Animator window by clicking the Animator icon in the Windows pane on the left-hand side of your IMPRINT Pro application.

   Alternatively, you can display this window or by choosing Animator from the Windows option under the View menu.

2. From the Execution menu, select the Settings option. In the dialog which appears, check the Animation On box.

3. From the Utilities menu, enable the Display Trace option. By choosing to display the full trace of the model execution in the Output window, the Animator window updates more frequently during the course of the model run.
4. Run the model.

   The Animator window updates as the model runs.
Animator Window for an Operational Mission
Chapter 2: Understanding the IMPRINT Pro Window

To set simulation speed:

You can set the simulation speed one of the following ways:

- Click the Simulation Speed option under the Execution menu, and then check 25, 50, 100, 200, 400, or 800%.
- Click the clock icon on the toolbar, and then check 25, 50, 100, 200, 400, or 800%.

To zoom the animation:

Zoom in or out one of the following ways:

- Select Diagram Zoom from the View menu, and then check a magnification level of 25, 50, 100, 200, 400, or 800%.
- Hold down the Ctrl key and move the wheel on the mouse.
To pan the animation:

Pan the animation one of the following ways:

- Hold the space bar down, and then move the mouse in the direction you want to pan.
- Click the wheel on your mouse, and then move the mouse in the direction you want to pan.

✓ Note:
Running the model with Animator on will slow down the model execution.

Event Queue Window

The Event Queue window displays the list of events as they occur during model execution. These include the execution of tasks and scheduled events. You create the scheduled events for the simulation. Scheduled events can be one-time events or they can repeat at regular intervals. The group, ID, tag, and type of event displays.

Beginning effects are highlighted in navy, ending effects are in green, suspended beginning effects are in blue, and suspended ending effects are in lime. Evaluate queue is in fuchsia, leaving queue is in purple, and waiting without queue is in red. And finally, external events are in yellow and snapshots are in maroon.
Chapter 2: Understanding the IMPRINT Pro Window

Network Diagram Window

The network diagram window displays the graphical depiction of the task network developed in a Mission model. Use this window to construct the network diagram and view the mission execution.

Output Window

The Output window displays the trace of the execution which consists of any actions as they finish in the course of the model run. The clock times for beginning effects, ending effects, and scenario events are listed. Application errors, plugin loading errors, and the start and end of a simulation are also included. Any syntax errors are indicated and you can use them for debugging purposes. You can save the information in the Output window to a file or to the Windows clipboard and clear the information in the window before running a new simulation.
Palette Window

The Palette displays the tools you use to construct the network diagram. These include tools for adding functions, scheduled functions, comments, groups, tasks, and goals. To add one of these items to the network diagram, click the item and drag it onto the network. You can then enter its defining parameters in the Properties window.

Windows Pane

The Windows pane contains a list of the windows that you can display in IMPRINT Pro and is intended to be a shortcut to quickly open a window. Windows include the Analysis Tree, Animator, Event Queue, Network Diagram, Output, Palette, Properties, Search, and Variable Watches.

In the default configuration, the Windows pane displays as a pane docked on the left side of the IMPRINT Pro window.
Properties Window

The Properties window displays the properties of the item selected in the network diagram, such as function, task, or goal. It also displays the properties of items that you select in the Analysis Tree such as variables, macros, external events, external model calls, snapshots and cultural events. The properties that display in the Properties window also display in the dialog box for the associated item.

The Properties window functions like any folder list. To expand an item, click the adjacent + sign. To collapse an item, click the adjacent - sign.

Some of the fields in the Properties window have an associated drop-down list box. To display the list box, click in the text box and a drop-down arrow displays. Click the arrow and a selection list appears. A detailed description of any selected item automatically displays at the bottom of the Properties window.

Variable Watches Window

The Variable Watches window displays the values of variables during mission execution. You select the variables that you want to display by creating a watch for the variable. The variable name, value, and type are displayed.
Status Bar

The status bar displays at the bottom of the IMPRINT Pro window. Any execution-related messages, such as the clock time and the run number, display on the right side of the status bar.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>abortmiss[0]</td>
<td>15.00000000</td>
<td>System.Doub</td>
</tr>
<tr>
<td>abortmiss[1]</td>
<td>15.00000000</td>
<td>System.Doub</td>
</tr>
<tr>
<td>Assignable[0]</td>
<td>1</td>
<td>System.Int32</td>
</tr>
<tr>
<td>CT CrewSize</td>
<td>0</td>
<td>System.Int32</td>
</tr>
<tr>
<td>DepotPool[63]</td>
<td>0</td>
<td>System.Int32</td>
</tr>
<tr>
<td>Distance[0]</td>
<td>20.0000000</td>
<td>System.Doub</td>
</tr>
<tr>
<td>DistMTT[0]</td>
<td>1</td>
<td>System.Int32</td>
</tr>
<tr>
<td>DistMTT[1]</td>
<td>1</td>
<td>System.Int32</td>
</tr>
<tr>
<td>DistMTTR[9]</td>
<td>1</td>
<td>System.Int32</td>
</tr>
<tr>
<td>Frag[0]</td>
<td>1</td>
<td>System.Int32</td>
</tr>
<tr>
<td>FragTime[0]</td>
<td>0.1666667</td>
<td>System.Doub</td>
</tr>
<tr>
<td>Fuelusage[0]</td>
<td>0.0000000</td>
<td>System.Doub</td>
</tr>
</tbody>
</table>

Window Configurations

IMPRINT Pro provides three customizable window configurations or views, Custom Layout 1, Custom Layout 2, and Custom Layout 3. These views default to the layouts described below.
- **Custom Layout 1** displays the default configuration of the Windows, Analysis Tree, Network Diagram, Properties, and Output windows. Tabs at the bottom of the windows display including Palette, Variable Watches, Event Queue, and Search.

- **Custom Layout 2** displays the default configuration of the Network Diagram, Analysis Tree, and the Output window. Tabs at the bottom of the windows display including Palette, Properties, Variable Watches, Event Queue, and Search. The Analysis Tree displays to the right.
- **Custom Layout 3** displays the Network Diagram, Analysis Tree, and Properties with tabs Output and Search. The Analysis Tree displays to the left.

The reset screen layout capability on the view menu enables you to return to these defaults at any time. For more information on how to move windows around, see “Manipulating Windows” on page 45.

**To change the layout configuration from the View menu:**

From the View menu, click **Layout**, and then select **Custom Layout 1**, **Custom Layout 2**, or **Custom Layout 3** from the menu that displays.

A check mark displays adjacent to the Layout command you have selected. The windows reconfigure to the selected layout.

**To change the layout configuration from the tool bar:**

From the Toolbar, click the **Custom Layout 1** button, **Custom Layout 2** button, or the **Custom Layout 3** button.

The windows rearrange to the selected layout.
Manipulating Windows

Any window in IMPRINT Pro that has a title bar is considered a Tool window, for example the Analysis Tree window. A tool window can be floating, docked, hidden, displayed in a vertical or horizontal tabbed format, and have an auto-hide property.

Floating Windows

When a window is floating, you can move it around as a separate window that floats on top of the other windows. You can move a floating window outside of the main IMPRINT Pro window.

To float a window:

1. Click the arrow in the right corner of title of the window, such as Analysis Tree or Properties.

2. Click Floating on the menu so that a check mark appears adjacent to the Floating item.

   The window appears as a separate window at the upper left corner of the screen.

Making Windows Dockable

When a window is dockable, you can move it with the mouse so that it snaps to the closest side of the IMPRINT Pro window.

To make a window dockable:

1. Click the arrow in the right corner of title of the window, such as Analysis Tree or Properties.

2. Click Dockable on the menu so that a check mark displays adjacent to the dockable item.

Docking Windows

Once you set a window to be dockable, you can dock it to any of the sides of the main IMPRINT Pro window.
**To dock a window:**

1. Drag the window toward an edge of the IMPRINT Pro window until you see a superimposed outline in the location you want.

As you drag the outline of the dockable window, four orientation dockable docking symbols appear, each at the outer edge of the IMPRINT Pro application window. By dragging the outlined window over one of these symbols, the window is docked along that edge of the application window.

A separate docking orientation key is also within the window over which the window outline is currently hovering. If you want to set your window down in any part of this location, simply drag your mouse to the edge of the symbol corresponding to the edge of the window where you want your window docked. Release the mouse button.

2. Release the mouse button.

When you dock a window over an existing window, both windows now exist in the same space, but you can only view one at a time. You can choose what window to view by clicking that window’s corresponding tab (located at the bottom of the window region.)
Displaying Tab Groups

You can display tabbed windows adjacent to each other so that they can be viewed at the same time.

To display a tab group:

1. Right-click the title of any of the tabs in the main window.

2. Do one of the following:
   - To display the tab in a horizontal format, click **New Horizontal Tab Group**.
   - To display the tab in a vertical format, click **New Vertical Tab Group**.

The windows rearrange to the selected format.
3. Repeat the previous step for any of the other windows.

**Hiding Windows**

Hiding a window completely removes the window from the display and frees up more working space. Hiding a window is the same as closing the window.

**To hide a window:**

Click the arrow in the right corner of title of the window, such as Analysis Tree or Properties, and do one of the following:

- Right-click the title bar of the window and select *Hide* from the shortcut menu that appears.
- Click the [X] in the upper right corner of the window.

The window is removed from the display.

**Redisplaying Hidden Windows**

Once a window is hidden, you can redisplay it using the View menu.

**To redisplay a hidden window:**

1. From the View menu, select *Windows*. 
2. Click the window you want to redisplay.

   The window redisplays in the last position it occupied. You can also redisplay a window using the Windows tab. For details, see “Windows” on page 33.

Auto-Hiding Windows

Auto-hide minimizes a window and places a tab with the window name on the closest edge of the IMPRINT Pro window.

To enable Auto-Hide:

   Do one of the following:
   • Click the arrow in the right corner of title of the window, such as Analysis Tree or Properties and select Auto-Hide on the menu that displays.
   • You can alternatively click the push pin icon on the title bar of the window. The icon points to the left when auto hide is enabled.

When you move the mouse and focus to another window, the window in auto-hide mode minimizes and a tab with its name displays on the edge of the IMPRINT Pro window.
Displaying Windows in Auto-Hide Mode

Windows in auto-hide mode display as a tab along the edge of the IMPRINT Pro main window with the name of the window.

To display a window in Auto-Hide mode:

Move the pointer over the window tab.

The window slides back into view and is ready for use. When you click the mouse off the window, the window loses focus and automatically slides back to the tab on the edge of the main window.

Disabling Auto-Hide Mode

Disabling auto-hide mode returns the window to its previous position.

To disable Auto-Hide mode:

1. Move the pointer over the tab for the window so that the window redisplay.

2. Right-mouse click the title bar of the window.
3. Select any option on the menu other than Auto-Hide, for example Dockable.

The window now becomes a docked window, and the Auto-Hide property is disabled.

Alternatively you may click the push pin icon on the title bar of the window. The icon points in a downward direction when auto-hide is disabled.

Moving Windows

Any docked or floating window may be moved to a new location in the IMPRINT Pro container window.

To move any window:
1. Click and drag the title bar of the window to the new location while holding down the left mouse button.
2. Release the mouse button when the window is in the new location.

Resizing Windows

To resize any window:
1. Rest the pointer over the border of a window until the pointer changes to →. 
2. Then, drag the border by pressing the left mouse button, and move the border to the new location.

Changing the Active Window

To make a window active, click anywhere in the window.

If the window is not currently displayed, do the following:
1. From the View menu, select the Windows.
2. From the submenu that appears select the window you want to make active. You can alternatively select the window from the Windows pane.
Closing Windows

To close a window:

Click the \[ \times \] in the upper right corner of the window or tab. You can alternatively right-click the title of the window and select Hide from the menu that displays.
Chapter 3: Overview of Analyses

This chapter describes the elements of an IMPRINT Pro analysis, including Warfighters, Missions, Equipment, Custom Performance Moderators, Forces and Plugins.

Warfighters Module

The Warfighters module helps you estimate the type and number of people that will be required to operate and maintain the system for the manpower, personnel, and training (MPT) analysis.

In Warfighters, you can select Specialties that are required, probably from a predecessor system, to operate and maintain the new system. It then permits you to see a profile of these specialties for the current year with estimates on their personnel characteristics.

For details on defining Warfighters, see "Warfighter Data" on page 67.

Questions that can be Answered in Warfighter Module

- What types of Warfighters (in terms of personnel characteristics such as mental aptitude, reading grade level, etc.) may be available to operate, maintain, and support a system?
- What types of people are currently in a Specialty?
- What percentage of the Warfighters in this Specialty are Test Score Category IV?
- What is the expected reading grade level of the crew?
- Are there major differences in the types of people in these Specialties?
- What percentage of this Specialty are high school graduates?
Elements of the Warfighters Module

The only element of the Warfighters module is the Warfighter. A warfighter is any person or automated device that operates, maintains, supplies or supports military equipment thus Warfighters are broken down into three categories: Operators, Maintainers and Supply and Support Personnel.

Mission Module

IMPRINT Pro allows you to analyze a new weapon system by helping you build models of each mission that the weapon system will be capable of accomplishing. Since it is typically easier to describe the mission by breaking it into smaller sub functions than trying to describe the mission as a whole, you build these models by breaking down the mission into a network of functions. Each of the functions is then further broken down into a network consisting of other functions and tasks.

Then, by executing the mission model simulation, you can study the range of results that occur in the mission. A description of the variability of each element can be obtained for further analysis.

The execution of a mission model begins at the level of individual tasks. Each task is assigned an estimated task time, either though a value or an expression. In addition, with each task, you estimate accuracy levels and assign workload values that reflect the amount of effort the Warfighter will have to expend to perform the task. During the simulation, IMPRINT Pro predicts task performance and calculates how much workload each Warfighter was experiencing throughout the mission. In this way, you determine whether the Warfighters were overloaded, and if so, how changes can be made to reduce the workload to an acceptable level.

At the completion of the simulation run, IMPRINT Pro compares the minimum acceptable mission performance time and accuracy to the predicted performance. This determines whether the mission met its performance requirements.

For details on defining a mission, see “Mission Analysis” on page 85.
Questions that can be Answered in the Mission Module

- How many people do I need in order to perform a set of tasks within my time constraints?
- How much visual, auditory, cognitive, motor and speech effort is involved in performing this process?
- What is the amount of workload a Warfighter will experience throughout the mission?
- Are any Warfighters overloaded?
- Is the current task allocation strategy balanced?
- How many people do I need in order to perform this process within my time constraints?
- What impact will workload have on mission performance time and accuracy?
- What impact will automation have on mission performance time and accuracy?
- Was the minimum performance time and accuracy of the mission completed as predicted?
- Were the performance requirements of the mission met?

Elements of the Mission Module

The central element of Missions module is the task network. The task network encompasses the following elements:

- **Warfighters** who represent the operators performing the tasks in your model.
- **Tasks** which represent the steps in the process or “mission” you are attempting to model.
- **Task Attributes** that specify the parameters associated with each task, including warfighter assignment, time, accuracy, and workload.
- **Functions** which contain sub-networks of tasks.
Paths which connect the functions and tasks in your model so as to direct the flow of entities running through your model when it is executed.

Goals which represent events external to the network modeled but which can have an impact on your mission when they fire.

RI Pairs, or resources and interfaces used by each operator in the mission.

Macros that return values or perform procedures when they are called in tasks.

Variables you define to represent changeable system states or characteristics, with values that change as tasks begin and end or scenario events occur.

Snapshots that collect the values of particular variables when triggered by conditions that you specify.

External Events that you schedule to occur at specific clock times to change the values of variables.

Charts that display the values of selected variables at run-time.

Cultural Templates that allows for the creation of a template to define the cultural and country differences that might cause people to react differently in a situation.

Plugins that communicate with other applications.

These elements and their interrelationships are shown in the following diagram. The diagram does not show a logical flow of model execution, but illustrates the general relationships between the aspects of a model.
Warfighters

Warfighters define a crew for your model. In an operational mission, Warfighters comprise Operators in your analysis who perform the tasks in your operations model. For each Warfighter you add, you can choose a specialty appropriate to the task the Warfighter will be assigned.

For each operator in the mission, you may additionally set a “default” flag to indicate that Warfighter’s role in the system as well as a workload threshold and workload management strategy to help model realistic operator actions under conditions of work overload. Lastly, you may designate the operator as an automated device if the task is to be performed by a machine.

Tasks

A task represents the most basic building block in the mission you are modeling.
**Task Attributes**

Every task you add to your network can be defined by the following seven attributes:

- **Time and Accuracy** - the length of time this task usually takes and the likelihood this task will fail.
- **Effects** - the circumstances which must occur before, during and after the firing of this task.
- **Failure** - the consequences as a result of this task failing.
- **Crew** - the operators who will be performing the task.
- **Taxons** - the categorization used to describe the workload composition of your task in a way that can be understood by performance moderators.
- **Paths** - the decision logic describing the conditions under which each of the individual paths leaving a task are taken.
- **Workload Demand** - value(s) indicating the relative demand on an operator performing a task.

The execution time for each task varies within the parameters you supply (usually distribution type, mean time, and standard deviation). Additionally, as each task executes it can alter the state of the system with expressions called “effects.” Effects are executed either at the beginning or at the end of a task. For example, the beginning effect of a machine task might decrease the number of available machines by one while the ending effect would increase the number by one.

Each task can also check the state of the system before it executes and delay execution until a certain condition, called a release condition, is met. For example, assume you define a variable named `Workers` that tracks the number of available operators. If you have a task that requires an operator to perform it, the condition `Workers > 0` must be true for the task to execute.

**Functions**

Functions are the primary organizing items of the mission network and represent groups (or networks) of tasks. Functions do not have performance estimates of their own. Rather, they only encapsulate tasks.
Paths

After adding the functions and tasks to your network to describe the different steps in your model, you must add the paths between them to direct the flow of your model. When you execute a model, an entity starts at the task you designate as the starting point. The entity then travels along the path(s), executing each task it encounters. When more than one path leaves a task, the decision on which path to take will be determined by the value set in the task’s decision node. Decision nodes are automatically added to a task by IMPRINT Pro and display in the network diagram as a diamond-shape on the end of a task node. Each contains a letter inside of it (S, T, P, or M) indicating the branching logic the entity should follow.

IMPRINT Pro uses four different branching logic decision types: Single, Tactical, Probabilistic, or Multiple. Tasks with Single nodes indicate the entity flowing through has only a single path it can follow at that point in the network. Tasks with Multiple nodes cause an entity to split up into multiple entities so that all paths out of the task are followed; these entities must later rejoin. The paths that the entity follows can vary, however, if you include probabilistic or tactical routing decisions. In a probabilistic decision, you specify the probability of each following task, and IMPRINT Pro selects the path to follow randomly within these probabilities. In a tactical decision, you specify the system conditions under which each following path can be selected. You can define these conditions and probabilities using expressions, operators, and variables that represent the state of the system.

Goals

IMPRINT Pro allows you to model human performance in a goal-driven context. This capability allows you to specify individual goals, the tasks associated with these goals, the triggering conditions, and the interaction of goals with each other and with workload.

RI Pairs

IMPRINT Pro provides capabilities for you to predict and assess the workload involved in performing tasks. This capability is consistent with well-known and documented theories of workload prediction, including the Wickens Multiple Resource Theory (MRT). ¹

Seven default human resources are provided within IMPRINT Pro. They include Auditory, Cognitive, Fine Motor, Gross Motor, Speech, Tactile and Visual. You can add more resources to the list if you desire. Additionally, you can identify specific interface elements (that is, controls and displays) that the warfighters will interact with. If your system design is not yet mature enough for that level of detail, then you can accept the default interface named “Crewstation.”

**Macros**

IMPRINT Pro uses two types of macros: built-in macros, which are available to all missions, and custom macros, which you define for use within a particular mission. Both macro types work in a similar manner. You can include the macro's name or call the macro in any expression. When IMPRINT Pro encounters the macro, it executes the algebraic and logical expressions in the macro and returns a value that can be used in the expression.

Built-in macros include the following categories:

- Modeling macros, which perform actions such as starting or stopping tasks, and pausing or stopping model executions.
- Mathematical macros, which perform mathematical operations, such as calculating the minimum, maximum, and trigonometric functions.
- Distribution macros, which generate random numbers for task execution according to a certain distribution.

Custom macros are particularly useful for calculations or procedures that you want to execute at more than one place in a model.

Example: You might create a macro to calculate machine utilization and use it to calculate utilization for various machines.

When macros are called in IMPRINT Pro, they are followed by parentheses, for example `CalculateTime()`. To return a value from a macro, the macro itself must be declared with a return value (for example, an integer).
Variables

Variables are an important element in any mission because they keep track of the state of the system. Three system variables are automatically created for each IMPRINT Pro mission, and you can additionally define variables specific to each mission.

The variables you define can keep track of whatever is appropriate for the mission—how many items are processed, what the current temperature is, or whether a machine is On or Off. Variables give different tasks, queues, and scenario events a way to interact with each other because they can evaluate and modify variable values.

Default system variables include the following:

- **Clock** records elapsed time (in simulation time units) since the beginning of model execution.
- **Distributions** allow access to all the model distributions. Distributions are used to determine task execution times.
- **Entity** includes all the entity variables.
- **Model** is used to control model actions, such as halt and pause.
- **Task** includes all property attached to each task in the network model.

Snapshots

Snapshots provide a way to collect values of variables at specified times during model execution. You can specify snapshots to be gathered at specific clock times (one-time or repeating), when a task begins or ends, when an entity enters or leaves a queue, or when a model run ends.

External Events

External events provide a way for you to cause events to occur at specific times during mission execution. These can be one-time events, or events that repeat at regular intervals. External events are often used to change variable values, thereby changing the state of the mission. For example, you might have a variable called temperature that would increase at 15-minute intervals during the day and decrease during the night. You could then make the times required for tasks such as warming up an engine be contingent upon the current temperature.
Charts

The Chart option allows you to display a plot of one mission variable against another. Since the value of your model’s variables is determined at run-time, the points representing these variables’ values are plotted on the chart at run time as the animation progresses.

Cultural Templates

In IMPRINT Pro, cultural modeling is defined as the application of cultural or country based influences on human behavior or performance within a human performance model. Given a situation with the same physical conditions and the same resources, people from different cultures or countries may react to the situation and apply their resources differently. A cultural difference exists when the average reaction of a population from one culture differs from that of another.

IMPRINT Pro allows users to create and save profiles, or templates, which define the relevant cultural parameters for each culture modeled and the values derived from cultural data that are assigned to those parameters. One or more templates can be defined by the user. At execution time, the user selects the template that is to be used.

The user selects the cultural parameters that are affected by a selected culture and assigns the appropriate values for those parameters based on the cultural data. IMPRINT Pro also allows the user to specify default values for each cultural parameter. The default value is used when cultural data for a parameter is not available.

Equipment Module

The Equipment module helps you estimate the maintenance manhours required to attain acceptable system availability.

This module lets you enter properties that control such items as the maintenance manpower pools, the spare availability, and the combat damage potential. These properties, coupled with a mission schedule and the data describing the maintenance actions that your system may need are combined in a stochastic maintenance simulation.

For details on defining an Equipment analysis, see “Equipment Analysis” on page 343.
Questions that can be answered in the Equipment Module

- How many people of each specialty do I need in order to meet the system availability requirement?
- Which pieces of equipment (such as subsystems) are the high drivers for maintenance?
- How should each organizational level be staffed?
- How sensitive is my maintenance manpower requirement to the failure rates of individual components?

Elements of the Equipment Module

Equipment elements include Subsystems and Scenarios.

- **Subsystem.** You will break your equipment analysis down into subsystems. A major subsystem is typically something like an engine, landing gear, or main gun. Next, you decompose your subsystem into components. Components are the individual pieces of equipment that have repair tasks attached. You can enter or edit maintenance data for all repair tasks associated with the components.

- **Scenarios.** A scenario is a configuration defining the set of conditions under which the components will be used. You can develop many scenario data sets for each system. For example, you might want to create one scenario for a thirty day run and another scenario that contains input parameters for a ten day run. When you have selected a scenario, you can add mission segment data for that scenario. You can add, duplicate, and delete scenarios.
Custom Performance Moderators

IMPRINT Pro allows you to create custom performance equations that can be used to affect task time or accuracy. These moderators can be either custom stressors or custom training moderators. This is done by identifying the moderator and then entering algorithms that link levels of the moderator to performance impacts by taxon. This is a way to embed your own experimental findings into an IMPRINT Pro model. To create a custom moderator, simply expand the Custom Moderators node in the Analysis Tree, add or select a custom stressor or custom performance moderator, add the desired moderator level(s), and then create corresponding algorithms for those moderator levels.

For details on defining custom moderators, see "Custom Performance Moderators" on page 427.

Force Module

The objective of the Force Analysis module is to help predict the manpower needed to perform the routine and unplanned work done by a force unit. Similar to the Define Equipment module in IMPRINT Pro, the Force Analysis module operates using a stochastic model which relies on various inputs you provide.

Questions answered by the Force Module

- What is the elapsed time for my planned and unplanned activities?
- What is the cumulative amount of time an activity was performed over the course of the entire model run?
- What was the status of an unplanned activity during the model run?

How many unplanned activities failed because the minimum number of Leaders, Sub-Leaders and Members required for this unplanned activity could not be met?
Elements of the Force Module

Force Analysis Data consists of the following items:

- **Force Units.** A Force Unit is a group of individuals who perform activities according to a schedule.

- **Schedule.** A Schedule is a pre-defined sequence of activities, planned and unplanned, over a specific amount of time.

- **Planned Activity.** A planned activity is a routine task. Examples may include guard duty, hygiene, eating and sleeping.

- **Unplanned Activity.** An unplanned activity is an activity which interrupts a normal schedule. Examples may include fire and emergency.

- **Activities Trump Matrix.** The Activity Trump Matrix is used to set task priority within a schedule for when any two activities overlap.

- **Jobs.** Jobs are general tasks, or occupations, which makes up a force unit. A job is defined by a name, specialty, rank and role. Examples may include Driver, Navigator and Analyst.

Plugins

IMPRINT Pro contains a powerful plugin interface that allows developers to extend the runtime functionality of the simulator. This API provides extensibility and flexibility that far exceed the External Model Call functionality of IMPRINT 7, yet is much easier to create, debug and use.

For details on creating a plugin, see “Using Plugins” on page 497.

Using plugins in a model is simply a matter of calling a method defined on a plugin object, passing to it those values desired, and using the result (if any). This can be done from any code window in the program: Effects, Release Conditions, or Expressions. Any public method defined in the plugin class will be available to all analyses in Imprint Pro. Any use of a plugin method will be checked for type compatibility by the Syntax Checker, so that modelers will know immediately if there are problems with their code.
Chapter 4: Warfighter Data

Use the Warfighters node to select and define a crew for your model. Warfighters comprise the Operators, Maintainers and the Supply and Support Personnel in your analysis. Operators perform the tasks in your operations model while maintainers and supply and support personnel maintain and supply/support the systems in your maintenance model. For each Warfighter you add, you can choose a specialty appropriate to the task the Warfighter will be assigned.

For each operator (operators only), you may additionally set a “default” flag to indicate that Warfighter’s role in the system as well as a workload threshold and workload management strategy to help model realistic operator actions under conditions of work overload. Lastly, you may designate the operator as an automated device if the task is to be performed by a machine.

Displaying Warfighters

To display warfighters in the Analysis Tree:

In the Analysis Tree, click the + adjacent to Warfighters node.

The following items display in a list below the Warfighters node:

- **Operators.** Only the Warfighters which are designated as Operators can perform tasks in the Mission model. On the Crew tab of the Task Information dialog box, operators can be designated as either Primary Operators or Contingency Operators. Only one Primary Operator is allowed per task. Operators are the only Warfighter type that may be assigned a name, workload strategy and an overload threshold.

- **Maintainers.** Warfighters which are designated as Maintainers can perform Repair Tasks. Whereas Operator Warfighters have a specific name independent of their Specialty, Maintainer Warfighters list in the tree only as the Specialty they represent (for example, 27X).

- **Supply and Support Personnel.** Warfighters designated as Supply and Support personnel appear in the Specialty combo boxes located in the Fuel Supply and Ammo Supply tabs under a Scenario and are listed in the tree by the specialty they represent (for example, 27X).
When you begin a new analysis, IMPRINT Pro provides you with one operator, one maintainer, and one supply and support personnel by default.

Adding Warfighters

Click the + beside the Warfighter node to view the Operators, Maintainers and Supply & Support Personnel nodes.

**To add a warfighter:**

1. Do one of the following:
   - Right-click the **Operators** node in the Analysis Tree.
   - Right-click the **Maintainers** node in the Analysis Tree.
   - Right-click the **Supply and Support Personnel** node in the Analysis Tree.

2. Then, do one of the following:
   - Select **New Operator** from the menu that displays.
   - Select **New Maintainer** from the menu that displays.
   - Select **New Supply & Support Personnel** from the menu that displays.

A dialog box displays a list of specialties along with their corresponding description, status and the military branch to which they belong. By default, all active specialties are listed at the top while all inactive specialties (obsolete) are at the bottom. Within those two groups, specialties are then ordered by the three-character designation under the Specialty field.

**To sort the list of available specialties:**

1. Click the column header to sort by.

The list of specialties reorders according to the column header category.

To reverse the sort order, click the same column header a second time. An up/down indicator displays on the column used for sorting and indicates the direction of the sort order.
2. In the name field at the top (Operators only), type in a name for the new Warfighter.

3. Click the Specialty and Description that most closely fits the attributes needed for the system.

4. Click **OK**.

The Operator, Maintainer or Supply and Support Personnel selected displays in the list below the corresponding node in the tree.

---

**Note:**

In the **Add** dialog, a column on the right-hand side of the window called “Obsoletes” displays. All specialties in the Warfighter selection lists are flagged as obsolete (True) or not obsolete (False). An obsolete specialty is one which no longer exists in the Army. All obsolete specialties appear, by default, at the bottom of the list.
Displaying Operators

To display a list of operators:

Do one of the following:

- Click the + to the left of the Operators node to display a list of Operators under the node.
- In the Analysis Tree, double-click the Operators node to display a list Operators in the main window.

Operators list in alphabetical order. The properties of each operator list in the columns to the right. For more information on these properties see “Displaying Operator Properties” on page 71.

Note:

IMPRINT Pro requires that one operator in the list be designated as the default operator. This operator automatically appears in your list of operators any time you create a new mission; it automatically appears with “(default)” next to its name. If this operator is deleted, the next operator to have been created after the deleted one becomes the new default operator.
Displaying Operator Properties

Use the Operator properties window to change an operator’s name and/or specialty, to set its automation flag, to set its workload management strategy, and to indicate whether or not the operator can be designated as a crewmaintainer for the system.

**Note:**
Only Warfighters of type Operator have properties in addition to specialty and specialty description.

**To display Operator properties:**

Double-click the operator below the Operator node.

The properties for that operator display in the main window and the Properties window.

Warfighter properties for Operators include:
- **Operator name.** The name of the operator displays in this box. Click in this field to edit the operator’s name.
• **Automated.** Click in the box and choose Yes to indicate if the operator is an automated device. Automated devices do not incur workload and therefore do not require Workload Strategy or Workload Threshold assignments. More and more functions are required to be automated - this does not necessarily make the path easier but is likely to change the nature of the path, the crew size, the task allocation, and the skills and abilities needed to follow the path.

• **Specialty.** Click the drop-down arrow in this box to view a list of all available specialty types to choose from for the selected operator. If an operator’s Automated field is set to True, the specialty field is disabled.

• **Default Strategy.** Click the arrow in the Default Strategy box, and then select one of the six possible management strategies (A-F) from the list that drops down. Selections A, E, and F require that you enter a Time Penalty and Accuracy Penalty. See “Operator Workload Management Strategies” on page 74 for more information on Workload Management.

• **Time Penalty and Accuracy Penalty.** IMPRINT Pro allows you to specify any time and accuracy penalties related to employing certain workload management strategies. You will be able to make entries for time and accuracy degradations to be applied to tasks that are reallocated during model execution. You will also be able to enter a time and accuracy degradation percentage to be applied when the operator attempts to perform all tasks regardless of the overload situation. The window displays any previously defined percentage of time and accuracy degradations for the appropriate workload management strategy. Position the mouse pointer in the field you want to edit and enter a value between 0 and 100 using the arrow, Delete, Backspace, and numeric keys.

• **Threshold.** Click in the Thresholds box and use numeric, arrow, backspace, and delete keys to enter/edit the threshold value. The workload threshold for each operator must be a number between 0 and 100. It is assumed that beyond the threshold, the operator is overloaded. The overall threshold is defined in terms of the total momentary workload index or score. When workload rises above the threshold during the simulation, IMPRINT Pro selects and applies a workload management strategy.

**Note:**
An operator whose total workload exceeds his/her workload threshold is not considered to be in overload if that operator is currently performing only one task.

**Note:**
Automation devices do not have workload thresholds.
• **Crew Maintainer.** Check this box to indicate that this operator is allowed to perform maintenance actions himself/herself instead of waiting for the system to be taken to a shop. This option is only available in circumstances where the required maintenance action, or repair task, is a **Remove and Replace** task, and spares are set to **100% available**. This concept is basically identical to “crew chief” in IMPRINT 7 with the following exception: in IMPRINT Pro this specialty performing the task does not always have to be the crew chief but can instead be someone else on the team. When two or more operators are flagged as crew maintainers, the existing mean time to repair (MTTR) for a repair task can be reduced since more bodies are available to help perform the task. The new MTTR in this case is calculated as follows:

\[
MTTR = \text{Existing MTTR} \times \frac{(#\text{Specialty1} + #\text{Specialty2})}{\text{(Number of available Crew Maintainers)}}
\]

where the Existing MTTR is the amount of time in hours that the repair task normally requires, and where Specialty1 and Specialty2 are the specialties required to perform this repair task.

For example, a Remove and Replace repair task normally requiring 2 hours time from a single 35R Avionic System Repairer flagged as a crew maintainer would be reduced to only one hour if an additional crew maintainer were available:

\[
MTTR = 2 \text{ hours} \times \frac{1 + 0}{2} = 1 \text{ hour}
\]

• **Default (Operators List and Analysis Tree only).** The default operator is the operator to which all tasks are initially assigned until they are manually reassigned to other operators. The word “default” appears next to the Operator in the Analysis Tree who acts as the default operator for that analysis.

### Changing Operator Specialties

You can change specialties of your Warfighters in the Warfighter Properties dialog box.
To change specialties for an operator:

1. Click the drop-down arrow next to the Specialty field.

The Specialty Directory, listing all Specialty types, opens.

2. Select a Specialty for the Warfighter that most closely fits the type of attributes needed for your system.

The Specialty list closes, and the new specialty appears in the Specialty box.

Operator Workload Management Strategies

Workload management strategies help you model realistic operator actions under conditions of work overload. Each operator must be assigned one default strategy to describe his or her actions under overload conditions.

During mission execution, if adding a new task causes the operator to surpass his workload threshold, the management strategies will be evaluated.
Entering a Default Management Strategy

**To enter a default strategy:**

Click the drop-down arrow in the Default Strategy box, and then select one of the six possible management strategies (A-F). Management strategies include:

- **A.** No effect, all tasks are performed regardless of overload.
- **B.** Does not begin the new task. New task is not started by another operator.
- **C.** Task are performed sequentially, beginning with the ongoing task and then the new task.
- **D.** Ongoing task is interrupted, new task is started. Ongoing task is started in “windows of opportunity.”

In the event the operator is already performing more than one task at the time that he or she is taking on a new task, IMPRINT Pro must determine which among the former tasks must be suspended in order that the new task may be taken on. To help determine which task in the group must be suspended, choose an option from the **Criterion** field. Criterion options include:

**Highest Priority.** The task with the highest priority is postponed. The priority value for a task is set in the Effects tab for that task. A task with a Priority setting of 1 has a higher priority than a task with a priority setting of 2.

**Lowest Priority.** The task with the lowest priority is postponed. The priority value for a task is set in the Effects tab for that task. A task with a Priority setting of 2 has a lower priority than a task with a priority setting of 1.

**Highest Task Difficulty.** A task involving a high amount of workload is defined as a difficult task thus the task with the highest total workload is determined to be the most difficult task and is therefore suspended. This total workload is determined by summing up all single task demand values assigned to this task across all channels and is exclusive of any conflict values.
**Lowest Task Difficulty.** A task involving a low amount of workload is defined as an easy task thus the task with the lowest total workload is determined to be the least difficult task and is therefore suspended. This total workload is determined by summing up all single task demand values assigned to this task across all channels and is exclusive of any conflict values.

**Most Recent.** The task which starts most recently before the new task is introduced is the most recent task; it is this task which is suspended whenever the operator reaches an overload condition as a result of having taken on additional newer tasks. In the case of a multiple decision node where several tasks along various branches start at the same time, the most recent tasks is determined by the order in which the paths from the decision node were drawn - the task along the path last drawn is the most recent task.

**Least Recent.** The task which starts least recently before the new task is introduced is the least recent task; it is this task which is suspended whenever the operator reaches an overload condition as a result of having taken on additional newer tasks. In the case of a multiple decision node where several tasks along various branches start at the same time, the least recent tasks is determined by the order in which the paths from the decision node were drawn - the task along the path last drawn is the least recent task. This task is also known as the “Top of the List” task because the path leading to it from the decision node displays at the top of the paths list of that decision node.

The task which is suspended by the criterion set in the operator’s window will once again be resumed by that operator provided that doing so allows the operator to continue in a non-overload situation.

ϝ E. Reallocate a task to the contingency operator.

In the event the operator is already performing more than one task at the time that he or she is taking on a new task, IMPRINT Pro must determine which among the group of tasks, including the former tasks and the new task, must be given to a contingency operator in order that the original operator can avoid an overload situation. To help determine which task in the group must be reallocated to the contingency operator, choose an option from the **Criteron** field. Criterion options include:

**New Task.** The most recent task presented to the operator is reallocated to the contingency operator.
**Highest Priority.** The task with the highest priority is reallocated to the contingency operator. The priority value for a task is set in the Effects tab for that task. A task with a Priority setting of 1 has a higher priority than a task with a priority setting of 2.

**Lowest Priority.** The task with the lowest priority is reallocated to the contingency operator. The priority value for a task is set in the Effects tab for that task. A task with a Priority setting of 2 has a lower priority than a task with a priority setting of 1.

**Highest Task Difficulty.** A task involving a high amount of workload is defined as a difficult task thus the task with the highest total workload is determined to be the most difficult task and is therefore reallocated to the contingency operator. This total workload is determined by summing up all single task demand values assigned to this task across all channels and is exclusive of any conflict values.

**Lowest Task Difficulty.** A task involving a low amount of workload is defined as an easy task thus the task with the lowest total workload is determined to be the least difficult task and is therefore reallocated to the contingency operator. This total workload is determined by summing up all single task demand values assigned to this task across all channels and is exclusive of any conflict values.

**Most Recently Added.** The task which starts most recently before the new task is introduced is the most recent task; it is this task which is suspended whenever the operator reaches an overload condition as a result of having taken on additional newer tasks. In the case of a multiple decision node where several tasks along various branches start at the same time, the most recent tasks is determined by the order in which the paths from the decision node were drawn - the task along the path last drawn is the most recent task.

**Least Recently Added.** The task which starts least recently before the new task is introduced is the least recent task; it is this task which is suspended whenever the operator reaches an overload condition as a result of having taken on additional newer tasks. In the case of a multiple decision node where several tasks along various branches start at the same time, the least recent tasks is determined by the order in which the paths
from the decision node were drawn - the task along the path last drawn is the least recent task. This task is also known as the “Top of the List” task because the path leading to it from the decision node displays at the top of the paths list of that decision node.

Selections A and E require that you enter a Time Penalty and/or Accuracy Penalty.

✔ Note:
In the event an operator is assigned workload management strategy E but no contingency operator has been assigned, this operator’s strategy will automatically default to strategy C.

Displaying Maintainers

To display a list of maintainers:

Do one of the following:
• Click the + adjacent to Maintainers node to display a list of maintainers below the node.
• Double-click the maintainer node to display Maintainer specialty.

A list of Maintainers for the analysis appears.

To display properties of an individual maintainer:

Double-click the desired specialty in the Analysis Tree below the Maintainer node.

The tabbed window corresponding to that Specialty appears.
In this window the three-character designation and description for that maintainer displays, for example, 00A M1 ABRAMS Tank Turret Mechanic. The Properties window also updates to display this same information.

Changing Maintainer Specialties

To change specialties for a maintainer:

1. Delete the current maintainer from the list.
2. Add a new maintainer to the list. Upon adding the new maintainer you may choose the new specialty from the list provided.

Displaying Supply and Support Personnel

To display a list of supply & support personnel:

Do one of the following:

• Click the + adjacent to Supply and Support Personnel node to display a list of supply and support specialties below the node.
• Double-click the supply and Support node to display a list of supply and support specialties in the main window. Specialties display in the main window and in the Properties window.

A list of Supply & Support personnel for the analysis appears.
To display properties of individual supply & support personnel:

Double-click the desired specialty in the Analysis Tree below the Supply & Support Personnel node.

The tabbed window corresponding to that Specialty appears.

In this window the three-character designation and description for that specialty displays, for example, 92Y Unit Supply Specialist. The Properties window also updates to display this same information.

Changing Supply and Support Personnel Specialties

To change specialties for supply and support personnel:

1. Delete the current supply and support Warfighter from the list.

2. Add a new Warfighter to the list. Upon adding the new Warfighter you may choose the new specialty from the list provided.

Deleting Warfighters

To delete a warfighter:

1. In the Analysis Tree, right-click the warfighter below the Operator, Maintainers, or Supply and Support Personnel node.

2. Do one of the following:
   • Select Delete Operator from the menu that displays.
   • Select Delete Maintainer from the menu that displays.
• Select **Delete Supply and Support Personnel** from the menu that displays.

The Warfighter is deleted along with all associated data for that warfighter.

### Cutting Warfighters

The Cut command allows you to move a Warfighter from one analysis to another. However, IMPRINT Pro allows you to cut **Operators only**. You cannot cut a Maintainer or any of the Supply and Support Personnel.

**To cut an operator:**

1. In the Analysis Tree, right-click the operator (for example, **Gunner**) below the Operator node.

2. Select **Cut Operator** from the menu which displays.

   The cut operator highlights in red and is copied to the Windows clipboard along with all its associated data. Once an operator is cut, you can paste the operator to a new analysis using the **Paste** command.

### Copying Warfighters

The Copy command allows you to copy a Warfighter from one analysis to another. However, IMPRINT Pro allows you to copy **Operators only**. You cannot copy a Maintainer or any of the Supply and Support Personnel.

**To copy an Operator:**

1. In the Analysis Tree, right-click the desired operator (for example, **Loader**) below the Operator node.

2. Select **Copy Operator** from the menu which displays.

   The operator copies to the Windows clipboard and may be pasted into other analyses.
Pasting Warfighters

The Paste command allows you to paste a Warfighter from one analysis into another. However, IMPRINT Pro allows you to paste Operators only. You cannot paste a Maintainer or any of the Supply and Support Personnel.

To paste an operator:

1. Cut or Copy an Operator.

2. In the Analysis Tree, click the + beside the Warfighters node in another analysis. Then right-click the Operator node.

3. Select Paste Operator from the menu which displays.

   The Operator pastes to the analysis along with all associated data for that Operator.
Chapter 5: Mission Analysis

IMPRINT Pro allows you to analyze a new weapon system by helping you build models of each mission that the weapon system will be capable of accomplishing. Since it is easier to describe the mission by breaking it into smaller sub functions than trying to describe the mission as a whole, you build these models by breaking down the mission into a network of functions. Each of the functions is then further broken down into a network consisting of other functions and tasks. Then, by executing the mission simulation, you can study the range of results that occur in the mission. A description of the variability of each element can be obtained for further analysis.

Mission Analysis is divided into subchapters describing:

- How to create a network diagram
- Properties for mission components
- Creating missions using an external template
- Settings that control mission execution
- Methods used to report the mission data

Subchapter 5.1 Mission Network Diagram

The graphical display of an IMPRINT Pro mission shows the functions, tasks, goals, comments, decision nodes, and paths connecting these items. Once you have analyzed the modeling process, drawing the network diagram in IMPRINT Pro is relatively easy. Using the tools on the Palette, you can place the functions, tasks, goals and comments onto the network diagram and then draw the paths to connect them. You can then define the properties for each task, goal and function individually. Once you have finished setting up your network diagram, you can run your model and watch the nodes representing your tasks in the network diagram highlight as the tasks fire.
Creating a Network Diagram

To create a network diagram:

1. If the network diagram window does not currently display, click **Window** from the **View** menu, and then click **Network Diagram**.

   Alternatively you can click the **Network Diagram** icon in the Windows pane.

   The network diagram displays. If the network diagram corresponds to a new mission you have just created, the network will contain only a Start node and an End node by default.

2. Display the Palette by clicking the Palette tab.

3. Add the network objects to your diagram by dragging the objects from the palette over to the network diagram. Network objects include functions, tasks, goals, and comments.
4. Draw the paths connecting the objects.

For details, see “Adding Network Objects” on page 88 and “Drawing Paths” on page 94.

5. Open the network object to display the description dialog box and Properties window.

- **Open task or comment.** To open task or comment dialogs, double-click the task or comment object on the Network Diagram or Analysis Tree. An informational tab corresponding to the task or comment appears in the main window.

- **Open functions or goals.** To open a function or goal description dialog, double-click the function or goal node in the Analysis Tree. Double-clicking the function or goal object on the network diagram will open a subnetwork.

6. In the fields provided, enter the defining properties.

Properties are described in “Mission Components” on page 115.

**Working with Network Objects**

Network objects include the functions, scheduled functions, tasks, goals, comments and workload monitors available on the tool palette. For detailed descriptions of these objects, see “Mission Components” on page 115.
Adding Network Objects

You can add objects to the network through the Palette or directly through the Network Diagram.

**To add a network object using the Palette:**

1. Open the Palette window.
2. Select the object you want to add.
   
   When you select an object, a green box displays around the object.
3. Drag the object to the Network Diagram.

   The object displays on the Network Diagram. The Analysis Tree also updates to display these new objects.

---

 ✓ **Note:**

   The Palette is unavailable for adding new network objects if a mission is not selected or if the Function Scheduler window is displayed.

---

**To add a network object directly in the network diagram:**

1. Right-click the network diagram.
2. From the shortcut menu which appears, select the **Add Node**... option.
3. Select one of the following options from the submenu which displays:
   - Add Function
   - Add Scheduled Function
   - Add Task
   - Add Goal
   - Add Comment
   - Add Workload Monitor
The object displays on the network diagram.

Opening a Network Object

Open the object to enter defining properties.
**To open a network object from the Analysis Tree:**

Double-click a node in the tree.

A new tabbed window appears for that node, displaying several fields where you can enter data for that item. Also, the Properties window updates to display these same fields for this item where this same information may be edited as desired.

**To open a network object from the network diagram:**

Double-click a node in the network diagram.

A new tabbed window will appear for that task or comment, displaying several fields where you can enter data. Also, the Properties window updates to display these same fields for this node where this information may be edited as desired.

Unlike tasks or comments, however, double-clicking on a function or goal node in the network diagram does not open up a tabbed window with fields; instead it opens up a new tab displaying the subnetwork of nodes this function or goal represents. The properties for this function or goal, however, continue to display in the Properties window and can be edited as desired.

Double-clicking a scheduled function opens the Function Scheduler window. This window displays all nodes contained by the scheduled function as bars along a Gantt Chart. Start times, end times and durations may be adjusted directly in the Function Scheduler display. Alternatively, These same properties also display in the Properties window where they can be edited as desired.

**Network Object Identification**

All tasks added to the network diagram are tagged with a unique ID to distinguish them from other objects in the network. This ID appears just before the task names in the nodes on the network diagram and also in the ID field in the Properties window when an object is selected. In the case where the ID appears as multiple numbers separated by underscores, the first number represents the node at the highest level of the network which contains the object. Each subsequent number represents the nth element (function) in the next level down in the network whose subnetwork further contains the object. The final number in the series before the task name shows the object as being the nth element added to the final level down in the network.
In the first example below, a total of four nodes have been added to the network in the following order: 1 Function, 2Function1, 3Task and 4Function2. The first number in each node reflects this order. Because there is only one number before the task name, it is understood that these nodes belong to the root level of the network diagram.

By double-clicking on 4Function2, we enter the second level of the network diagram. This is evident by the fact that all node IDs in this level contain two numbers in series.

By default, a Start and End node appear in the subnetwork, each prefixed in this case with a “4” to indicate they are contained by the function in the level above having an nth element ID of “4”.

In this level we add four more nodes:
All new nodes begin with the number “4” to indicate they are also part of the sub-network owned by the fourth element (function) in the level above. In addition, each node also has a second number separated by an underscore to indicate it is at the second level in the network diagram, and even more specifically the nth element added to the subnetwork. In the example above, the highlighted node is the third element added into the subnetwork of the fourth element (function) in the level above.

By double-clicking this function we dive down one level deeper into the network diagram. Adding a function to this level results in the function’s ID being $4_{3\_1}$. This indicates it is the first element in the subnetwork of the third element (function) in the level above, which in turn belongs to the fourth element (function) at the root level of the network diagram.

The final number appearing after the task name indicates the nth node added to the mission as a whole. This number increments by 1 each time a new object (function, task or goal) is added anywhere in the mission. Any time an object is deleted and a new one is added to replace it, the nth element number of the new object will still be unique.

By deleting the original function above and adding a new one, we see that the new function’s final number, in this case “7” is one greater than the previous function’s number. The ID numbers belonging to deleted objects are not reused for newly added objects.
Deleting Network Objects

You can delete any of the network objects. If you delete a function or a task, the associated paths are automatically deleted.

To delete a network object:

1. Click the object you want to delete.
   A green box displays around the object.

2. Do one of the following:
   • Press the Delete key on the keyboard.
   • Right-click the mouse, and then click Delete from the menu that displays.

Moving Network Objects

You can move any of the network objects on the network diagram. Any associated paths automatically move and adjust to the new location.

To move a network object:

1. Click the object once with the left mouse button.
   A box displays around the object to show it is selected.

2. Click the object again, and while pressing the left mouse button, move the object to the new location.
Drawing Paths

Paths connect functions and tasks on the network diagram. Paths control the flow of execution during the simulation.

To draw a path:

1. Do one of the following:
   • For a function, move the pointer over the right-most edge of the network object that is the start point for the path. The pointer changes to a hand.
   • For a task, move the pointer over the decision icon for the task that is the start point for the path. The decision icon is shaped like a diamond and displays on the right side of the task icon.

2. Left-click the mouse, and while pressing the mouse button, draw the path to the destination task or function.

3. Release the mouse button.

   The path displays, highlighted in green and marked with an arrow at the endpoint to show the path direction.

Displaying Path Logic

You can display the dialog box that describes the logic or code for a path. Path logic is contained in a task’s Paths Tab. For additional details, see “Task Information Dialog Box – Paths Tab” on page 157.

To display path logic:

1. Double-click the task node to display the Task Information screen.

2. Click the Paths tab.

   The Paths Description dialog box for the path opens and displays the path logic in a code window. For each additional path leaving the task, an additional code window displays below. Code windows appear in the order in which their respective paths were created.
Removing Paths

To remove a path:

1. Click the path with the left mouse button.

   Small green squares and diamonds display on the path. Squares outline each path segment, and diamonds display at the beginning and end of the path.

2. Press the Delete key on the keyboard.

   The path is removed.

   Alternatively, click the path using your right-mouse button, and then choose Delete Network Path from the menu that displays.

Zooming the Network Diagram

Using the zoom feature of IMPRINT Pro, you can view a specific part of the diagram in detail or broaden the diagram view.

To zoom the network diagram:

From the View menu, click Diagram Zoom, and then select the magnification level. Magnification levels vary from 25% to 800%.

The network diagram redisplays at the magnification level you selected.

Alternatively, if your mouse has a wheel, the network diagram may be zoomed by rolling the mouse up or down while holding down the Ctrl key at the same time.

Panning the Network Diagram

You can pan the network diagram to display areas that are not currently in view. When panning, you can move the mouse in all directions.

To pan the network diagram:

1. Press the space bar.

   The pointer changes to this shape: 🧡
2. Move the mouse in the desired direction.

3. When you reach the section of the network diagram you want to view, release the space bar.

Alternative options for panning:

- Pan the display by dragging the blue view box in the bottom pane of the Palette window over the desired region of the network diagram.
- Pan the display by using the scroll bars in the Network Diagram window.
- If your mouse has a wheel, the network diagram may be panned also by rolling the mouse up or down while holding down the \textit{Shift} key at the same time.

## Changing Network Levels

**To move down a network level:**

On the Network diagram, double-click a function.

A new task network window opens displaying the network of tasks.

If you choose to instead move down a network level in a \textit{scheduled function}, the Function Scheduler window appears instead of a task network. The Function Scheduler window displays all subnodes (tasks, functions and scheduled functions) as bars along a Gantt chart. In the Function Scheduler window, you can continue moving down subsequent network levels within that particular scheduled function by double-clicking a bar which corresponds to the desired node whose network detail you wish to view - a new Function Scheduler window for that node displays.

**To move up a network level:**

At the top of the Network Diagram window, click the tab corresponding to the desired function level.

The network corresponding to this function level displays.

\textbf{\textit{Note:}}

If the tab for the desired function level does not appear at the top of the Network Diagram window, go back to the main Network Diagram window, navigate through the network until the desired function is reached, and then double-click the function; the network corresponding to this function level displays.
Editing Text and Objects

With IMPRINT Pro tools you can select text or a network diagram object, such as a function, task, path, or comment. Once selected, you can copy, cut, delete, and paste text and objects.

Selecting Text or Objects

Before you can edit text or objects, you must first select them. The selection of an item depends on whether the item is a text string or an object on the network diagram.

To select a text string:

1. Open the Description dialog box or Properties window for the network diagram object containing the text string to be selected.

2. Do one of the following:
   • To select a string of text, click with the mouse and drag the mouse through the text.
   • To select a word, double-click the word.

To select an object in the network diagram:

Click the item once with the left mouse button.

A box displays around the object to show it is selected. Paths leading out of the object are highlighted in red, and paths leading into the object are highlighted in blue. When you select a path, small triangles display at the beginning and endpoints of the paths; small squares display outlining each path segment.

To select multiple items on the network diagram, do one of the following:

• Click and drag the mouse to create a box around the items.
• Press the Shift or Ctrl key while clicking the items with the mouse.

Upon releasing the mouse button, selected items appear highlighted in the network diagram.

✓ Note:
Items selected with the box method (first method listed above) appear selected only if the entire object is contained within that box.
Copy Text and Objects

The Copy command copies the selected text or object to the Windows clipboard. Copying an object copies all of the object’s properties. Once the text or object is on the clipboard, you can use the Paste command to insert it elsewhere in the model or into another application see “Pasting Text and Objects” on page 99.

To copy text:

Select the text to copy, then do one of the following:

• Right-click the selected text, and then click Copy from the menu that displays.
• From the Edit menu, click Copy.
• On the tool bar, click the Copy button.

The text is copied to the clipboard.

To copy an object:

Select the object to copy, and do one of the following:

• Right-click the selected object(s) and select Copy from the menu that displays.
• From the Edit menu, select Copy.
• On the tool bar, click the Copy button.

The object(s) are copied to the clipboard.

Cutting Text and Objects

You can cut text and objects using the Cut command. Cutting places the text or object on the clipboard where it may then be pasted elsewhere in the analysis or in another application. Once the item is pasted, it is removed from its original location.

To cut text or an object:

Select the text or object to cut, and then do one of the following:

• Right-click the selected text or object, and then select Cut from the menu that displays.
• From the Edit menu, select Cut.
• On the tool bar, click the Cut button.

The cut item is copied to the clipboard. You can now paste this item elsewhere in IMPRINT Pro or in another application.

Deleting Text and Objects

You can delete selected text and objects without placing them on the clipboard by using the Delete function. This method is especially useful for deleting something that you do not plan to reuse, especially if the clipboard currently contains an item that you do not want to lose.

To delete text or an object:

Select the text or object you want to delete, and then do one of the following:
• Press the Delete key on the keyboard.
• Right-click the node and select Delete from the menu that displays.

The text or object is deleted.

Pasting Text and Objects

Items cut or copied to the clipboard can be pasted elsewhere in IMPRINT Pro using the Paste command. If the clipboard is empty, or if the current clipboard item is not in a format appropriate for the current location, the Paste command appears grayed out so that you cannot select it. You cannot use the Paste command to replace a network that is currently displayed or any network above it.

To paste text or an object:

1. After copying the text or object you want to paste, do one of the following:
   • Right-click to paste text or objects.

   **Text.** Right-click in the area you want to paste the text to, and then select Paste from the menu that displays.

   **Objects.** Right-click anywhere in the network diagram, and then select Paste node(s) from the menu that displays. The pasted text or object displays.

   • From the Edit menu, click Paste.
• On the tool bar, click the **Paste** button.

For objects on the network diagram, the pasted object is on top of the copied object. IMPRINT Pro automatically assigns a new ID to the item. The name is similar to the copied item, but is incremented. For example, you could have My Task as the original task, and then My Task 1 as the pasted copy.

2. For objects on the network diagram, select the pasted object and use the mouse to move it to the new location.

**Pasting Objects to Mission Model or Analysis**

IMPRINT Pro provides a Task Data Mapping Wizard to help you copy a task from one mission (or analysis) to another. By default, every task in the network is associated with at least one Warfighter. During the copy and paste process, however, you may be attempting to copy or move a task using Warfighter X to a different mission (or analysis) where the only available Warfighters are Warfighter Y and Warfighter Z. The Task Data Mapping Wizard leads you through a few steps to transition the copied task into the new environment, prompting you to reassign your task to one of these alternate Warfighters or specifically to the default Warfighter for your destination analysis.

Also, if the task you choose to paste also has Workload Demand values attached to it, you will be prompted to map these demand values in the destination analysis, as well.

**To paste a network object to another mission or analysis:**

1. Right-click the network object you want to copy, and then select **Copy** from the menu that displays.

2. Right-click the mission or analysis to which you want to paste the network object to, and then select **Paste node(s)** from the menu that displays.

   The Task Data Mapping Wizard will open.

---

✓ **Note:**
   MPRINT Pro does not use the Task Data Mapping Wizard to paste Comments.
Chapter 5: Mission Analysis

Mapping Warfighters

When the Task Data Mapping Wizard opens, you are given two options:

- **Set Primary Warfighter to Default.** Select this option to force the copied task to accept, as its Primary Warfighter, the default Warfighter of the analysis or mission to which it is being copied. By default the Primary Warfighter for any analysis or mission is the initial Warfighter that IMPRINT Pro automatically adds whenever a new analysis is created. If this default Warfighter is deleted, IMPRINT Pro will assume a new default Warfighter from your list of available Warfighters.

- **Copy Primary and any Contingency Warfighters.** Select this option to allow IMPRINT Pro to map the Primary and Contingency Warfighters of your copied task to specific Warfighters available in the destination analysis or mission. If you choose this option, follow these steps:

  1. Choose a Warfighter from the Source Warfighters list.

  2. In the field to the right under Mapped Warfighters, click the field to reveal the drop-down arrow.

  3. Click the arrow to display a list of Warfighters available in the destination analysis.
4. Select a new Warfighter.

The **Next** button is enabled.

5. Lastly, you will be reminded that you should check all mean times, effects, release conditions, etc. for the task you have just copied to verify they are still valid. Some values may have been reset to the default values during the copy process.

**Mapping Workload Demand Values**

In the event the task you choose to paste also has a Workload Demand attached to one or more of the resource-interface pairs from the source analysis, a second page in the Task Data Mapping Wizard displays, helping you to map these demand values to new RI pairs in your destination analysis. In your source analysis, these demand values were originally set through the Workload Demand tab in the main Task Information screen.

The wizard displays the following two options:

- **Do not copy Workload Demand values.** Choosing this option drops the Workload Demand values associated with the pasted task.
Copy Workload Demand Values using the following mapping for RI Pairs. Choosing this option carries the Workload Demand values set in the source analysis to the destination analysis, prompting you to first remap the resource-interface pairs with which they should be associated.

This page displays all resource-interface pairs in both the source and destination analyses.

Copying the Network Diagram as an Image

You can copy the viewable portion of the network diagram, as an image, to the Windows clipboard. This image may then be pasted into an image editing application. Only the graphical depiction of the network is copied. You cannot paste the diagram into IMPRINT Pro.

To copy a network diagram:

1. Open the mission to copy.

2. Right-click in the network diagram, and select Copy Diagram as Image from the menu that displays. Alternatively, you may select Copy Diagram as Image from the Edit menu.

An image of the viewable portion of the network diagram is copied to the clipboard. You can now paste the contents into an image editing application.

Printing the Network Diagram

The Network Diagram and portions of it may be printed by using the Print Diagram option. Before printing the network diagram, IMPRINT Pro displays a preview of how the network diagram will appear when printed. From this window, you control the zoom factor, the number of pages that are viewed, and can add header information.

To print the network diagram:

1. Select the mission whose network diagram you wish to print.

2. Do one of the following:
   - Right-click inside the network diagram window, and select Print... from the menu which appears.
• From the File menu select Print...

The Network Print dialog box appears.

3. Select the desired print option. The Print Diagram option allows you to print the network diagram in three different ways:
   • Entire Network. Print the entire network diagram (this may require several printed pages depending on the size of the selected network.)
   • Selected. Print only the currently-selected nodes and paths from the network diagram.
   • Visible. Print only the portion of the network diagram currently visible in the Network Diagram window.

The Print Preview window displays.

4. Do any of the following:
• To zoom the view, click the down arrow adjacent to the magnifying glass icon and select the zoom level.

• To view more than one page at a time when the network diagram extends over more than one page, click one of the buttons to the right of the Magnifying glass: one, two, three, four, or six pages.

• To add a header to the network diagram, click the Page Setup button and type the header information. The header information prints on each page.

• To change the size that the diagram is printed, click the Page Setup button, and then select the size from the Zoom list box.

• To close the Print Preview window, click the Close button.

5. When you are ready to print the network diagram, click the Print button on the Print Preview window.

Users with Adobe Acrobat installed on their systems may print to PDF using the instructions below, provided this option displays in the list of available printers (see the Printers option under the Page Setup window.)

### Printing the Network Diagram to a PDF File

*To print the Network Diagram to a PDF file:*

1. Select the network diagram you wish to print.

2. Do one of the following:
   • Right-click inside the network diagram window, and select Print Network Diagram from the menu that appears.
   • From the File menu select Print Diagram.

3. Select the desired print option: Print Network, Print Selected or Print Visible.

   The Print Preview window appears.

4. Click the Page Setup button.

5. In the lower right-hand corner of the Page Setup window, click the Printer button.

   A second Page Setup window appears, listing your default printer.

6. Click the drop-down arrow next to your default printer to access the list of available printer options.
7. From the list select Adobe PDF.

8. Click the Properties button to access formatting options for the PDF file to be generated.

   It is recommended the “Prompt for Adobe PDF Filename” option be checked before clicking Ok to this window.

9. Click Ok to all remaining Page Setup windows.

10. In the Print Preview window, click the Print button.

    The Save PDF File As dialog box appears.

11. Click the drop-down arrow next to the Save in field to navigate to and select a new folder in which to save the file, if desired.

12. Enter a name in the File name field.

13. Click the Save button.

    The PDF file generates and saves to the directory specified.

---

Subchapter 5.2 Working With Missions

IMPRINT Pro allows you to analyze the performance (such as time, accuracy, and workload) of a new weapon system by helping you build models of each mission that the weapon system will be capable of accomplishing. Models are built by breaking down the mission into a network of functions. Each of the functions is then further broken down into a network consisting of other functions and tasks.

When you execute the mission model simulation, you can study the range of results that occur in the mission. A description of the variability of each element can be obtained for further analysis.
IMPRINT Pro performs the simulation model based on how long you tell it to perform each task in the mission. In addition, with each task, you estimate accuracy levels and assign workload values that reflect the amount of effort the Warfighters will have to expend to perform the task. During the simulation, IMPRINT Pro predicts task performance and calculates how much workload each Warfighter experienced throughout the mission. In this way, you determine whether the Warfighter were overloaded, and if so, how changes can be made to reduce the workload to an acceptable level.

At the completion of the simulation, IMPRINT Pro can compare the minimum acceptable mission performance time and accuracy to the predicted performance. This will determine whether the mission met its performance requirements.

**Displaying Missions**

In IMPRINT Pro, a single analysis can contain numerous missions. Each mission has its own list of elements below it which include RI Pairs, Macros, Variables, Snapshots, External Events and Cultural Templates.

*To display mission names:*

In the Analysis Tree, double-click the Missions node below the desired analysis.

For the selected analysis, IMPRINT Pro displays a list of missions in the main window under the Missions tab. Each mission listed is accompanied by its assigned mission Time Requirement. For more information on Time Requirement, see "Editing Mission Properties" on page 112.
Alternatively, you may access the list of missions for your analysis by clicking the + adjacent to it to expand the list.

The list of missions appears below the Missions node.

If there are no missions listed, you will need to add a mission. For details, see “Adding Missions” on page 109.

Once you have selected a mission, the mission name will also appear in the Properties window. By default, this window appears on the right side of your screen when you choose Custom Layout 1. If the Properties window is hidden, it can be brought back at any time by selecting it from the Windows option under the View menu. The name of your mission appears in the top of the window, and all other properties of the mission display below.
Adding Missions

This option allows you to add a new operational mission to this analysis. Initially the new mission will have a name only and no associated data (such as functions and tasks).

**To add a mission:**

1. In the Analysis Tree, right-click **Missions**.
2. Click **Add Mission** from the menu that displays.

A mission will be added below the Mission node in the Analysis Tree and to the list of missions in the main window.

**Note:**
By default, the first mission added in IMPRINT Pro is initially named Mission. Every subsequent mission added is also named Mission, but is appended with a number that increments by one, for example “Mission2, Mission3,...etc.” You can edit the name of the Mission in the Mission Properties window name box or in the name box on the Mission information dialog box.
Selecting Missions

To select a mission:

In the Analysis Tree, below the Mission node single-click a Mission name (for example, Mission1).

A network diagram displays along with the mission data in the Properties window. You will use the network diagram to add functions, tasks, goals, and comments to the mission.

For detailed information on adding Functions and Tasks to the Network Diagram, see “Mission Components” on page 115.

Displaying the Mission Properties

To display the Mission dialog box:

Double-click an existing mission below the Missions node in the Analysis Tree.

A new tab appears in the main window, displaying properties of this mission. This same data also displays in the Properties window. If not previously selected, this new mission now becomes the currently-selected mission.
Mission Properties

Mission properties includes:

- **Mission Name.** At the top of the dialog box is the Mission Name.

- **Mission Description.** In the Description box you can add a textual description of the mission.

- **Time Requirement.** The Time Requirement is the maximum acceptable time by which the mission must be performed in order to be considered a success.

- **Time Criterion.** The Time Criterion is the percentage of mission runs that must be performed within the mission time requirement in order to be considered a success. Since the elements of the mission are variable, the predicted mission performance will also vary. The criterion allows you to account for this, and gives you an opportunity to specify a realistic percentage of runs that must meet the standards.

- **Accuracy Criterion.** At the task level, an accuracy failure can lead to mission abort. Mission Accuracy Criterion lets you specify the percentage of time in which the mission must complete without an abort in order to be considered a success.
Mission Criterion. The Mission Criterion is a percentage that represents how often the mission must meet both its time and accuracy requirements at the same time in order to be considered a success. Occasionally, your mission may be able to miss either the Time or Accuracy Requirement, but here you define how often it must meet both.

Later, you can execute a simulation model of your mission. The results of that mission analysis will be compared to the requirement and criteria you enter here.

Editing Mission Properties

To edit the values in the Mission Properties window:

1. Position the pointer in the box you want to change.
2. Click once to set the insertion point in the box.
3. Type in the new value.

Note:
By default, the format for the Mission Time Requirement value and other time values in IMPRINT Pro is HH:MM:SS.mm, and the colons are required. You may change the current time format to a different format through the Time tab in the Preferences dialog, located under the Edit menu.

Deleting Missions

To delete a mission:

1. In the Analysis Tree, click the Mission you want to delete and do one of the following:
   • Right-click the mission, and then select Delete Mission from the menu that displays.
   • Press the Delete key on the keyboard.
2. At the delete confirmation prompt, click OK.
3. The mission is deleted from the tree along with all its associated data.

✔ Note:
Although deleting a mission causes it to disappear from the analysis in the tree, the mission is not deleted from the database until the analysis containing it is re-saved afterwards.

Cutting Missions

You can move a mission from one analysis to another using the Cut command.

To cut a mission:

Do one of the following:

• Right-click the mission you want to move, and select **Cut Mission** from the menu that displays.
• Select the mission in the tree, and then select **Cut** from the **Edit** menu.
• Select the mission in the tree, and then click the **Cut** button.

The cut mission is highlighted in red. To paste the mission, see “Pasting Missions” on page 114.

Copying Missions

To copy a mission:

Do one of the following:

• Right-click the mission you want to move, and select **Copy Mission** from the menu that displays.
• Select the mission in the tree, and then select **Copy** from the **Edit** menu.
• Select the mission in the tree, and then click the **Copy** button.

The mission and all its associated data are copied to the Windows clipboard. To paste the mission, see “Pasting Missions” on page 114.
Pasting Missions

*To paste a mission:*

1. After you cut or copy a mission, select the Missions node to which you want to paste your copied mission.

2. Do one of the following:
   - Right-click the destination Missions node, and select **Paste Mission** from the menu that displays.
   - Select the destination Missions node in the tree, and then select **Paste** from the **Edit** menu.
   - Select the destination Missions node in the tree, and then click the **Paste** button in the tool bar.

   The cut or copied mission will be added below the destination Missions node.

**Note:**
If you are pasting the mission to a mission node in a different analysis, the Task Data Mapping Wizard will display. For more information on how to use the Task Data Mapping Wizard, see “Pasting Objects to Mission Model or Analysis” on page 100.

Scheduled Missions

As an alternative to a conventional mission whose Start node fires immediately as the “Run Model” button is activated, **Scheduled Missions** allow you to create a mission which starts at a specific clock time instead. This is because scheduled missions are comprised entirely of **scheduled tasks and functions**, all of which have their own specifically scheduled start and end times. These times may be set in the **Properties** window of any task or function selected within this type of mission. It is the first task in the root level of the network (or in the first function’s lowest level) whose start time determines the start of the mission.

*To add a scheduled mission:*

1. Right-mouse click the **Missions** node in an analysis.
2. From the shortcut menu that appears, select **New Scheduled Mission**.

The new scheduled mission appears in the **Analysis Tree** under the **Missions** node.

Scheduled Missions are simply a mission-level representation of **Scheduled Functions**; the method for adding and setting the nodes in each remains identical. For more information see "Scheduled Functions" on page 122.

**Mission Components**

The network diagram of an IMPRINT Pro mission shows the functions, tasks, decision nodes and paths connecting these items. You can also add other text to the network diagram and display values of variables on the network diagram as the mission runs.

In addition to the graphical network diagram, IMPRINT Pro uses RI pairs, variables, macros, snapshots, external events, and cultural templates in the mission simulation. All of these items are defined in description dialog boxes or in the associated Properties window.

**Functions**

IMPRINT Pro helps you break a mission down into its functions. Examples of functions are:

- Acquire Target
- Engage Target
- Communicate

In addition, IMPRINT Pro helps you identify maximum acceptable performance times for each function. IMPRINT Pro helps you link the functions together in a network that makes up the mission.

✔ **Note:**
A function can contain other networks within it.

A list of functions associated with the mission displays in the Analysis Tree below the Network node. You can add, edit, and delete functions, and display function descriptions.
Adding Functions

To add a function to the network diagram:

Do one of the following:

- From the Palette, drag the Function object to the correct place on the network diagram.
- Right-click the Network node in the Analysis Tree, and select Add Function for the menu that displays.
- Right-click the network diagram, and then select Add Function from the menu that displays.

Note:
IMPRINT Pro will name your new function Function. If you continue to add functions, each following function will be named FunctionX where X is the next integer. You can edit the name of the function in the Function Properties Window name box.

Displaying Function Properties

To display the Function properties:

Double-click the function below the Network node in the Analysis Tree.

The Function Information tab appears in the main window, showing properties of this function. The Properties Window also updates to display this same information.

For more information on Layout, see “Window Configurations” on page 42.

Function Properties

The name of the mission to which this function belongs displays at the top of the Function Information tab. This tab contains three data elements:

- **Function Name.** This is a short description of the function and is the label that is written into the node when the network diagram is displayed.

- **Time Requirement.** This value is the maximum acceptable performance time for this function.

- **Criterion.** This value is the percentage of times that this function must meet its time standard to be considered successful.
Editing Function Information

To change function information:

1. Position the pointer in the box you want to change.
2. Click once to set the insertion point in the box.
3. Type in the new value.

The format for the time value is HH:MM:SS.mm, and the colons are required.

Function Properties Window

The Properties Window contains additional information about your function that is not included in the Function Information tab, for example the Function ID and the Tree Parent Object.

The Function ID is an identification number which is generated when the function is created. At the root level of the network, all IDs are an integer representing the place that function lies in the sequence of functions created at that level. For example, a function with an ID of 2 means that this was the second function created at this level. Adding a function at the next level (within an existing function’s network) adds one level of complexity to the Function ID: it is prefixed with “X_” where X is the ID of the parent function. For example, 3_2 represents the second function created in the task network belonging to function 3, and function 3 sits at the root level of the network.

ID’s do not affect sequence and are merely task label information. Sequence is solely determined by which paths you draw between nodes.
The Tree Parent Object is the function containing your selected node, i.e. the Parent Function. In many cases this function may be the top level of the network in which case the Tree Parent Object is labeled as “Untitled(Root)”. 

Deleting Functions

A function and all its associated data can be deleted from the Analysis Tree and network diagram. This command can not be undone.

To delete a function:

On the network diagram, select the function and do one of the following:

• Press the **Delete** key on the keyboard.

• Right-click the function on the network diagram, and select **Delete Function** from the menu that displays.

• Right-click the function in the Analysis Tree, and select **Delete Function** from the menu that displays.

The function is removed. All associated tasks are also deleted.

Copying Functions

A function and all its associated data can be copied and pasted into another network.

To copy a function:

Do one of the following:

• Right-click the function you want to copy, and then select **Copy** from the menu that displays.
• Right-click the function node below the Network node in the Analysis Tree, and then select Copy Function from the menu that displays.
• Select the function on the network diagram, and then click the Copy button on the tool bar.

**Cutting Functions**

**To cut a function:**

Do one of the following:

• Right-click the function node in the **Network Diagram** and then select **Cut Function** from the menu that displays.
• Right-click the function node below the Network node in the Analysis Tree, and then select **Cut Function** from the menu that displays.
• Select the function on the network diagram, and then select **Cut** from the **Edit** menu.
• Select the function on the network diagram, and then click the **Cut** button on the tool bar.

The function is highlighted in red. When you paste the function into another mission network, IMPRINT Pro will remove the function from its current location to the new location.

**Pasting Functions**

**To paste a function:**

Copy or cut the function, and do one of the following:

• Right-click the network diagram, and then select **Paste Node(s)** from the menu that displays.
• Right-click the destination Network node in the Analysis Tree, and then select **Paste Node(s)** from the menu that displays.
• Click the Network Diagram to which you want to paste the function, and then select **Paste** on the **Edit** menu.
• Click the Network Diagram to which you want to paste the function, and then click the **Paste** button on the tool bar.

The function appears in the Network Diagram. If you used the Cut command, the cut function will be removed from its previous location.

**Note:**
If you are pasting the function to a network node in a different analysis, the Task Data Mapping dialog box will display. For more information on how to use the Task Data Mapping dialog, see “Pasting Objects to Mission Model or Analysis” on page 100.

### Changing the Appearance of Functions

Functions are represented by a rectangular shape on the network diagram. You can change the colors and shapes of a function.

**To change the appearance of a function:**

1. In the **Edit** menu, click **Preferences**.
2. Choose the **Shapes and Colors** tab.
3. From the **Select Node Type** drop-down box, select **Function**.
4. Choose the desired shapes and colors for the network nodes using the drop-down lists provided.
5. Click **Ok**.

Nodes in the Network diagram update to the new preference settings.

### Subnetworks of Functions

When a function in the network is very complex, you may want to simplify it by dividing it into more specific tasks. You can do this by defining the function as a subnetwork. A subnetwork can contain all the same elements as the main network—functions, tasks, paths, decisions, queues, and subnetworks at a lower level—and is defined by its own network diagram. In addition, a subnetwork can have a release condition similar to a task, and it can be preceded by a queue. Subnetworks are represented by the default green rectangular shape on the network diagram while tasks are represented by a rounded rectangular shape with a diamond attached.
To display the subnetwork diagram:

Double-click a function in the Network Diagram.

A lower level diagram will display. You can place functions and tasks on this diagram by using the Palette or by right-clicking on the diagram and selecting Add Function or Add Task from the menu that displays.

Adding Functions to Subnetworks

To add a function to a subnetwork:

Do one of the following:

• Right-click the function representing the subnetwork to which the new function should be added. From the menu that displays, click Add Function.
• From the Palate, select the Function object, and then drag it to the subnetwork diagram.
• Right-click the Function node in the Analysis Tree, and then select Add Function from the menu that displays.
• Open the subnetwork by double-clicking the function node on the network diagram, right-click the subnetwork diagram, and select Add Function from the menu that displays.

A function will be added below the Function node in the Analysis Tree and to the subnetwork diagram.

Adding Tasks to Subnetworks

To add a task to a subnetwork:

Do one of the following:

• Right-click the function representing the subnetwork to which the new task should be added, and then select Add Task from the menu that displays.
• Right-click the function in the Analysis Tree you want to add a task to, and select Add Task from the menu that displays.
• From the Palate, select the Task object and drag to the subnetwork diagram.
• Open the subnetwork by double-clicking the function node on the network diagram, right-click the subnetwork diagram, and select Add Task from the menu that displays.

A task will be added below the function in the Analysis Tree and to the subnetwork diagram.
Adding Comments to Subnetworks

Comments can be used to add headers for clarification, add other text to the diagram, and to display values of variables for display on the network diagram during the model run.

To add a comment to a subnetwork:

Do one of the following:

- Right-click the function representing the subnetwork to which the new comment should be added, and then select Add Comment from the menu that displays.
- Right-click the function in the Analysis Tree you want to add a comment to, and select Add Comment from the menu that displays.
- From the Palette, select the Comment object and drag to the subnetwork diagram.
- Open the subnetwork by double-clicking the function on the network diagram, right-click the subnetwork diagram, and select Add Comment from the menu that displays.

A comment will be added to the function subnetwork diagram.

Scheduled Functions

Similar to regular functions, Scheduled Functions help you break a mission down into its functions. Different from regular functions, however, scheduled functions determine the start and end times of the tasks they contain using optional scheduled start and end times rather than by the progression of a network flow. By using a scheduled function, a task can start at a specific clock time within the context of the scheduled function rather than waiting for a node before it in the same subnetwork to finish.

A scheduled function is itself a subnetwork of nodes which contains one or more tasks, functions and/or other scheduled functions. Each node is triggered by the scheduled start and end times you specify (path logic in these subnetworks does not exist.) For each scheduled function added, a minimum of one subtask must exist in its subnetwork; the last task in a scheduled function’s subnetwork cannot be deleted unless the scheduled function contains a separate scheduled function in its network which does contain a task. The lowest level of any scheduled function must contain at least one task.
A list of scheduled functions associated with the mission displays in the Analysis Tree below the Network node. You can add, edit, and delete scheduled functions either through the tree, through the network or through the Function Scheduler window available by double-clicking any scheduled function node in the network diagram. Scheduled function descriptions and properties may be displayed through the Properties Window.

Each scheduled function has optional performance properties to set which help identify its maximum acceptable performance times. The performance of each scheduled function is determined by the performance of the nodes it contains.

**Adding Scheduled Functions**

*To add a scheduled function to the network diagram:*

Do one of the following:

- From the Palette, drag the Scheduled Function object to the correct place on the network diagram.
- Right-click the Network node in the Analysis Tree, and select the Add... option from the shortcut menu. From the submenu which displays, select Add Scheduled Function.
- Right-click the network diagram, and then select Add Scheduled Function from the menu which displays.

✓ **Note:**

IMPRINT Pro names your new scheduled function ScheduledFunction. If you continue to add scheduled functions, each following function will be named ScheduledFunctionX where X is the next integer. You can edit the name of the scheduled function in the Scheduled Function Properties Window name box.
Displaying Scheduled Function Properties

To display the Scheduled Function properties:

Double-click the scheduled function below the Network node in the Analysis Tree.

The Scheduled Function Information tab appears in the main window, showing properties of this function. The Properties Window also updates to display this same information.

For more information on Layout, see “Window Configurations” on page 42.

Scheduled Function Information Tab

The name of the mission to which this scheduled function belongs displays at the top of the Scheduled Function Information tab. This tab contains the following data elements:

- **Scheduled Function Name.** This is a short description of the function and is the label that is written into the node when the network diagram is displayed.

- **Time Requirement.** This value is the maximum acceptable performance time for this function.

- **Criterion.** This value is the percentage of times that this function must meet its time standard to be considered successful.

- **Schedule (for nodes within a scheduled function only).** The Schedule parameters include a Start time and a Stop time to specify the exact times in your model when your scheduled function should begin and end within the context of the parent function’s timeline.
Scheduled Function Properties Window

The Properties Window contains additional information about your scheduled function that is not included in the Function Information tab, for example the Function ID and the Parent Object ID.

The Function ID is an identification number which is generated when the function is created. At the root level of the network, all IDs are an integer representing the place that function lies in the sequence of functions created at that level. For example, a function with an ID of 2 means that this was the second function created at this level. Adding a function at the next level (within an existing function’s network) adds one level of complexity to the Function ID: it is prefixed with “X_” where X is the ID of the parent function. The Parent Object is the function containing your selected node, i.e. the Parent Function. In many cases this function may be the top level of the network in which case the Parent Object is labeled as “Untitled(Root)”. For example, 3_2 represents the second function created in the task network belonging to function 3 (this task’s parent function), and function 3 sits at the root level of the network.

ID’s do not affect sequence and are merely task label information. Sequence is solely determined by which paths you draw between nodes.

The Scheduled Function Properties window also includes a **Description** field at the bottom of the window. As you select items in the Properties window to edit, the Description field updates to display the definition of the item you are editing.
Editing Scheduled Function Information

To change scheduled function information:

1. Position the pointer in the box you want to change.
2. Click once to set the insertion point in the box.
3. Type in the new value.

The default format for the time value is HH:MM:SS.mm, and the colons are required. For more information on changing the time format see the IMPRINT Pro User Guide Volume 1 Chapter 5: IMPRINT Pro Menu Structure, Edit Menu, Preferences.

Deleting Scheduled Functions

A scheduled function and all its associated data can be deleted from the Analysis Tree and network diagram. This command can not be undone.

To delete a scheduled function:

On the network diagram, select the scheduled function and do one of the following:

- Press the Delete key on the keyboard.
- Right-click the scheduled function on the network diagram, and select Delete Scheduled Function from the menu that displays.
• Right-click the function in the Analysis Tree, and select **Delete Scheduled Function** from the menu which displays.

The scheduled function is removed. All associated tasks are also deleted.

**Copying Scheduled Functions**

A scheduled function and all its associated data can be copied and pasted into another network.

*To copy a scheduled function:*

Do one of the following:

• Right-click the scheduled function you want to copy, and then select **Copy Scheduled Function** from the menu that displays.

• Right-click the function node below the Network node in the Analysis Tree, and then select **Copy Scheduled Function** from the menu that displays.

• Select the function on the network diagram, and then click the **Copy Scheduled Function** button on the tool bar.

**Cutting Scheduled Functions**

*To cut a scheduled function:*

Do one of the following:

• Right-click the function node in the **Network Diagram** and then select **Cut Scheduled Function** from the menu that displays.

• Right-click the function node below the Network node in the Analysis Tree, and then select **Cut Scheduled Function** from the menu that displays.

• Select the function on the network diagram, and then select **Cut** from the **Edit** menu.

• Select the function on the network diagram, and then click the **Cut** button on the tool bar.

The cut scheduled function highlights in red. When you paste the scheduled function into another mission network, IMPRINT Pro will remove the scheduled function from its current location to the new location.
Pasting Scheduled Functions

To paste a scheduled function:

Copy or cut the scheduled function, and do one of the following:

- Right-click the network diagram, and then select Paste Node(s) from the menu that displays.
- Right-click the destination Network node in the Analysis Tree, and then select Paste Node(s) from the menu that displays.
- Click the Network Diagram to which you want to paste the scheduled function, and then select Paste on the Edit menu.
- Click the Network Diagram to which you want to paste the scheduled function, and then click the Paste button on the toolbar.

The function appears in the Network Diagram. If you used the Cut command just prior to the Paste command, the cut scheduled function is removed from its previous location.

✓ Note:
If you are pasting the scheduled function to a network node in a different analysis, the Task Data Mapping dialog box will display. For more information on how to use the Task Data Mapping dialog, see “Pasting Objects to Mission Model or Analysis” on page 100.

Changing the Appearance of Scheduled Functions

Scheduled Functions are represented by a rectangular shape on the network diagram. You can change the colors and shapes of a function.

To change the appearance of a scheduled function:

1. In the Edit menu, click Preferences.
2. Choose the Shapes and Colors tab.
3. From the Select Node Type drop-down box, select Scheduled Function.
4. Choose the desired shapes and colors for the network nodes using the drop-down lists provided.
5. Click **Ok**.

Nodes in the Network diagram update to the new preference settings.

**Subnetworks of Scheduled Functions**

Similar to regular functions, a scheduled function is designed to help divide a portion of your network into more specific tasks and functions and/or subfunctions. You can do this by defining the scheduled function as a subnetwork.

A subnetwork contains all the same elements as the main network—functions, additional scheduled functions and tasks at a lower level. Unlike regular functions, however, which are defined by a series of elements connected together in a network, the subnetwork of a scheduled function is defined by similar elements which are positioned along a timeline or “Gantt chart”, sequenced instead by the Start Times and Stop Times set for each. These start and stop times are set within the context of the parent object timeline. This charting and scheduling method of subtasks and subfunctions is done using the **Function Scheduler**.

**Displaying Subnetworks of Scheduled Functions using**
the Function Scheduler

To display a scheduled function using the Function Scheduler:

Double-click a scheduled function in the Network Diagram.

The Function Scheduler window appears.

This window displays the content of the selected scheduled function in the form of a Gantt chart.

Name. The name of the selected scheduled function

Parent. The name of the parent object of the scheduled function

In the Function Scheduler all tasks contained by the scheduled function display as purple bars while all scheduled functions contained by the scheduled function display as blue bars. The corresponding task or function name and ID display to the left of the bar. The start of each bar is positioned relative to the timeline displayed at the top of the Function Scheduler window according to the task’s or function’s set start time, and the end of each bar corresponds to the Stop time. The length of bar represents the duration of the task, function or scheduled function selected.

Modifying the Function Scheduler Display

The Function Scheduler allows you to control the range of time displayed in your scheduled function. Scheduled tasks and functions within the display scale and translate accordingly.
To modify the Function Scheduler display:

1. Locate the timeline at the top of the display. Note that the display defaults to displaying one hour of time within each segment.

2. Click the left-pointing arrow as needed to expand a smaller section of the timeline.

3. Click the right-pointing arrow as needed to advance to a point along the timeline further from the start.

Alternatively, click and drag on the timeline itself to shift the display window.

Adding Nodes to the Subnetwork of a Scheduled Function

Tasks, functions and/or additional scheduled functions may be added to the subnetwork of any selected scheduled function.
To add a node to a subnetwork of a scheduled function:

Do one of the following:

• In the Analysis Tree, right-click the Scheduled Function node representing the subnetwork to which the new function should be added, and then select the Add Node... option. From the submenu which displays, select the option corresponding to the node you wish to add. Options include Add Task, Add Scheduled Function and Add Function.

• In the Function Scheduler window, right-click in the space underneath the listed subtasks and subfunctions, and then select the Add Node... option. From the submenu which displays, select the option corresponding to the node you wish to add. Options include Add Task, Add Scheduled Function and Add Function.
For root-level scheduled functions only:

- On the root-level network diagram, right-click the scheduled function representing the subnetwork to which the new function should be added, and then select the **Add Node...** option. From the submenu which displays, select the option corresponding to the node you wish to add. Options include Add Task, Add Scheduled Function and Add Function.

A new function displays below the selected scheduled function node in the Analysis Tree; the same new function also displays in the Function Scheduler window.

**Modifying Nodes of a Subnetwork in the Function Scheduler**

The start time, stop time and duration of any node inside the Function Scheduler window can be altered using the bars on the Function Scheduler display.
To modify a node in the Function Scheduler:

1. Position the cursor at the edge of the bar of the node you wish to modify. The cursor changes to a double arrow.

2. Select the direction in which to drag the cursor.

3. Drag the cursor in the intended direction until the bar represents the desired length of the task.

4. Release the mouse. The new time displays.

Tasks

IMPRINT Pro helps you break a mission down into its basic tasks.
Examples of tasks are:

- Tune Radio
- Push Button
- Clear Cannon

IMPRINT Pro helps you enter the relevant data elements for each task, such as timing information, execution constraints, effects of the task on the system, and routing information. Finally, it allows you link the tasks together in a network that makes up the mission.

A list of tasks associated with each function displays in the Analysis Tree below their respective parent functions under the Network node. You can display task descriptions, and add, edit, and delete tasks.

Adding Tasks

You can add a task to your network diagram or subnetwork one of four ways.

To add a task:

Do one of the following:

- Right-click the Function node in the Analysis Tree, and then select Add Task from the menu that displays.
- Right-click in the network diagram or subnetwork, and then select Add Task from the menu that displays.
- From the Palette, select and drag the Task object to the correct place on the network diagram or subnetwork.
- Right-click the Function node on network or subnetwork diagram, and select Add Task from the menu that displays.

Note:
IMPRINT Pro will name your new task Task. If you continue to add tasks, each following task will be named TaskX where X is the next integer.
Displaying Task Information

To display the Task Information:

On the network diagram in the Analysis Tree, double-click the task.

The Task Information tab displays in the main window. The associated Properties window for the task also displays.

Task Information Dialog Box Overview

Above the tabs on the task information dialog box, you will see the Mission name, the Task ID, the Function name, and the Task name. The Task name is a short description of the task and is the label written in the node when the Network Diagram is displayed.
The Task Information dialog box contains many data elements and is grouped into areas that contain related information. The tabs include the following:

- **Timing & Accuracy** data
- **Effects** data
- **Failure** data
- **Crew** assignment data
- **Taxon** assignments
- **Path** decision type data
- **Workload Demand** data

When you first enter this dialog box, you will see either the last data sheet you were in for this task or the default Time and Accuracy data sheet. To view data related to one of the other topics mentioned above, click its corresponding tab at the top of the screen.

**Task Information Dialog Box – Time and Accuracy Tab**

Click the first tab on the **Task Data** dialog box to show the **Time and Accuracy** dialog box.

The dialog box has the following information:

**Time and Accuracy Requirements**

Beginning at the top of the dialog box below the task name, the first group of data displayed includes the performance standards for this task. These values define how well the task needs to be performed to be considered successful. Values include:

- **Time Requirement.** The Time Requirement is the maximum acceptable performance time for this task.

- **Accuracy Requirement.** The Accuracy Requirement is the minimum acceptable accuracy for this task in order for it to be considered a success.

- **Accuracy Measure.** Accuracy Measure is a unit corresponding to the nature of how your task’s accuracy is measured. This unit helps IMPRINT Pro to determine whether your task is more or less accurate when the number pulled from the accuracy
distribution is greater or less than the requirement you set. For example, assume that your Accuracy Measure is set to Percent Steps Correct and your Accuracy Requirement is set to 80. If the number pulled from the Accuracy distribution is 85, then IMPRINT Pro will consider this accuracy value to be a success since 85% is better than 80% in the context of Percentage of Steps Correct. If, however, you intend choose the unit of Measure Feet from Desired, IMPRINT Pro will consider this accuracy value of 85 to be a failure since 85 is less accurate that 80 in the context of Feet from Desired.

- **Criterion.** This value is the percentage of time that this task must meet both the time requirement and the accuracy requirement simultaneously to be considered successful.

When IMPRINT Pro executes your mission, the Distribution and its parameters are used to choose a specific task time for each occurrence of each task. These times are then accumulated throughout the model run and compared to the time requirement in order to report the percentage of successes for each task. Similarly, the Probability of Success (calculated based on the Accuracy Mean, Accuracy Standard Deviation, and Accuracy Requirement) is used to determine whether the task has succeeded or failed each time it occurs. These successes and failures are then accumulated throughout the model run in order to report the percentage of accuracy successes for each task.

**Estimated Task Time**

The second group of data elements on this dialog box describe the estimated task time. The Estimated Task Time is the amount of time a task will take to execute as calculated by IMPRINT Pro. Estimated Task Time may be specified either by using a distribution or by entering an expression for time. Depending on the values you enter for the distribution or the expression you use, the task times could vary each time the task is executed.

**Distributions**

To calculate a task time using a distribution, you must first choose a distribution type. In the Estimated Task Time Distribution list, 22 different distributions are available for choosing. Depending on the distribution type you choose, you must then enter between one and three parameters (Parameter 1, Parameter 2 and Parameter 3) to define the limits of this distribution.
Once you have selected your distribution type and entered the values to define it, IMPRINT Pro determines a distribution, or range, of possible values it can assign to your task’s time. When IMPRINT Pro runs your model, a random number generator is used to pull a number from this distribution of values. The number pulled becomes the new Estimated Task Time for that occurrence of the task.

**Note:**
Of the available 20 distribution types, IMPRINT Pro uses, by default, the Normal distribution which uses Mean and Standard Deviation to predict a task performance time. Depending on the distribution type you choose to use, different and/or additional properties such as Shape, Probability of Success, Maximum, Minimum and Scale, might also be required.

- **Distribution.** The distribution describes the statistical distribution properties from which the actual occurrence time will be drawn. (If you are unfamiliar with statistical distributions, we recommend that you consult a statistics textbook or someone more knowledgeable in this field.) By default, IMPRINT Pro uses a Normal distribution for several of its parameters.

- **Parameter 1, Parameter 2 and Parameter 3.** The values required by the selected distribution type to determine a range of values for your task’s time.

In the example of the Normal distribution which IMPRINT Pro uses quite frequently, the fields for Parameter 1 and Parameter 2 represent the Mean and Standard Deviation of the distribution. The Mean represents the average amount of time the task will most likely take any time it is performed. Standard Deviation is a measure that tells you how closely all the various task times calculated by IMPRINT Pro are clustered around the mean task time. In general, one standard deviation away from the task mean time in either direction (greater than or less than the mean) accounts for somewhere around 68 percent of all computed task times. Two standard deviations away from the mean account for roughly 95 percent of the computed task times. And three standard deviations account for about 99 percent of the computed task times. By specifying the Standard Deviation for your task, you are helping IMPRINT Pro to determine how widely varied (or unvaried) the distribution of all your different calculated task times will be.

If you choose to change the distribution type, for example a Triangular distribution type, Parameters 1, 2 and 3 now represent the Mode, Minimum and Maximum values which this distribution type requires in order to define a range of values for your task’s time.

**Expressions**

In place of a distribution, you may use an expression to set the estimated time for a task. To use this feature, click the **Use Expression** radio button in the **Estimated Task Time** window, and then enter an expression in the code box provided.

Expressions can be as simple as designating a set time for your task (00:00:30;) which will be used every time the task fires, or they can instead be much more complicated expressions involving operators or statements, for example (if clock<=30 then 10 else 15;). Each expression you include should be delimited by a semicolon. In building the expressions, you can use any of the algebraic or logical operators, including the following: (&&, ||, >, <, =,==, +, -,*, and /). You can also use if-then-else statements. The assignment operator is =. The equivalence operator is ==.


**Estimated Task Accuracy**

As a compliment to the Estimated Task Time in which you compute a distribution of times for your task, the Estimated Task Accuracy is used to compute a distribution of successes (and failures) for the same task. Essentially, you are specifying the part of the task that will make it randomly succeed or fail, causing your model to exercise the various failure consequences throughout your model run. The items necessary for specifying task accuracy include:

- **Mean Accuracy.** The Mean Accuracy is your estimate of the most likely, or average, Accuracy value for this task.

- **Accuracy Standard Deviation.** The value specifying how tightly all the various values in the distribution are clustered around the Mean Accuracy value.
Probability of Success. The Probability of Success is the likelihood that a task will succeed each time it is executed. This number can either be manually entered or can be calculated as a result of entering values for the remaining three fields upon which it is dependent, namely the Mean Accuracy, Accuracy Standard Deviation and the Accuracy Requirement.

To calculate these values, you must first think of the task’s performance in terms of Accuracy. IMPRINT Pro pulls a random accuracy value from a distribution of values, and then assigns it to your task. If this value meets a requirement you set, your task can then be considered a success. If this value falls short of your requirement, your task is then considered a failure. To generate these random task accuracies you must first set up a distribution in the Estimated Task Accuracy section of the Task window. The distribution type used by IMPRINT Pro for the accuracies is always a Normal distribution for which you must enter a Mean Accuracy, Standard Deviation, Accuracy Requirement and the Probability of Success.

The first step in this process is to set a Mean Accuracy. This value is the average value (or center) in the distribution. Most of the values in the data set will be close to this average while relatively few tend to one extreme or the other.

Next, you must specify the Accuracy Standard Deviation. By specifying the Standard Deviation for your task, you are helping IMPRINT Pro to determine how widely varied (or unvaried) the distribution of all your different calculated task accuracies will be from the average (it is essentially the shape of the distribution curve.) In general, one standard deviation away from the task Mean Accuracy in either direction (greater than or less than the mean) accounts for somewhere around 68 percent of all computed task accuracies. Two standard deviations away from the mean account for roughly 95 percent of the computed task accuracies. Three standard deviations account for about 99 percent of the computed task accuracies.

An easy rule of thumb for specifying the standard deviation is to compute the difference between the worst and best performance and divide it by 6.

Example: If the worst performance is 40% steps correct and the best is 100%, then an estimate for the standard deviation would be 10% (((100 - 40)/6) = 10).
Next, if you have not already done so at the top of the page, you must enter the task Accuracy Requirement. Each value that is pulled from your accuracy distribution will then be compared to this value. If a value falls above this requirement, the task is considered accurate enough to be a success, provided the Accuracy Measure dictates a higher value is better (for example, % Steps Correct, % Desired.) For this same situation, a value falling below this threshold would be one in which the task would be considered a failure. In a different context, however, where the Accuracy Measure determines that a lower value is better (for example, Minutes from Desired or Feet from Desired) an accuracy value that falls short of the Requirement value may be considered a success whereas a value that falls above the Requirement value would be considered a failure.

We realize that it is often difficult for users to think of accuracy in these terms, and that it is often easier to think of it in terms of the probability of success. To accommodate this fact, we have provided a Probability of Success field in which you may manually enter a value. If, however, you are uncertain about what this value should be based on the other values entered, you may calculate it using the Accuracy Calculator located on the Toolbar at the top of your screen.

1. Open the Accuracy Calculator.

2. Select the option button for Probability of Success.

3. Enter in your data for the remaining three values in the fields provided.

4. Click the Calculate button. The Probability of Success value is calculated using standard statistical procedures that compute the area under a Normal statistical curve. IMPRINT Pro is also careful to evaluate your accuracy measure to determine whether bigger values are better (for example, percent steps correct), or smaller values are better (for example, mils from desired).

5. Click the Apply to Selected Task button – your new Probability of Success value appears in the Task window.

Note: You may use the Accuracy Calculator to calculate any one of the four required values provided the other three are entered.

**Editing Time and Accuracy**

To change the values in this dialog box:

1. Click once to set the pointer in the box you want to edit.
2. Type in the new value.

✓ Note:

By default, the format for the task Time Requirement value and other time values in IMPRINT Pro is HH:MM:SS.mm, and the colons are required. You may change the current time format to a different format through the Time tab in the Preferences dialog, located under the Edit menu.

Task Information Dialog Box – Effects Tab

In this dialog, you can enter arithmetic or logical expressions to control when a task is released during a model run and what effect its execution will have on other parts of the model (variables, tasks, etc.). You can also enter task priority and interrupt strategy.

The following are detailed descriptions of the properties in the Effects tab.
**Task Priority.** Task priorities are used to execute priority-based workload management strategies. The priorities range from 1.0 (highest priority) to 5.0 (lowest priority). New tasks are assigned a priority level of 3.0 (medium). To change a priority level for a task, click in the task priority field and enter a priority value between 1.0 and 5.0, or click the drop box in the task priority field and select a priority from the list.

**Note:**
For all models imported or updated from previous versions of Pro using the convention of highest priority as 5 and lowest priority of 1, IMPRINT Pro will automatically convert, upon import, those previous priority values to the new convention where 1 is highest and 5 is lowest.

**Interrupt Strategy.** The interrupt strategy is used to describe whether the task can be resumed after being interrupted or if it needs to be restarted. Tasks in the Resume category can pick up where they left off. In contrast, tasks in the Restart category pay a time penalty for interruption. They must start over again. To change the interrupt strategy, select either Resume or Restart from the Interrupt Strategy box.

**Release Condition.** Release Condition is an expression that determines whether or not the task can execute. A task can execute only when the expression in the release condition evaluates to true. The default value is \( \text{return (true);} \)

A Release Condition can be useful in the event you have a mission which contains tasks that you want to execute only under certain conditions. For example, it would not make sense for a tank commander to issue a fire command while the loader is loading the ammunition. Rather, he must wait until the loading is complete. To ensure that tasks are released only when the state of system has reached an appropriate point or when required resources are available, you need to use a release condition \( \text{return (loading == false);} \) or \( \text{return (loading==true);} \)

If you have used any multiple decision types in your model, you will need to use Release Conditions, Beginning and Ending effects, to rejoin the multiple paths at the proper point in the network.
Chapter 5: Mission Analysis

Release Conditions are used to check the state of a system before a task executes and suspend the execution of the task until a certain condition is met. A release condition is an expression that is False when the task is not available and has is True when the task is available. In order to restrict the conditions under which a task can execute, a release condition must be defined. To restrict the task's availability, define a release condition that is True only under the circumstances in which you want the task to execute.

Semicolons delimit the release condition expressions. In building the expressions, you can use any of the arithmetic or logical operators, including the following: !<, &&, |, >, <, =,==, +, -, *, and /. You can also use if-then-else and while-do statements. The assignment operator is =. The equivalence operator is ==. For more information on arithmetic or logical operators, see Expressions in IMPRINT Pro Syntax Reference Manual, Vol. 3 of IMPRINT Pro User Guide.

You should exercise caution when adding expressions to a release condition for two reasons. First, a lockout condition can occur when a release condition is never met; the task is Locked out of the mission. When this occurs, you receive a Job can never be released message when the mission ends and a task is still waiting for its release condition to be met.

Second, it is very important that the release condition be used only for evaluating whether a job can be executed, rather than to initialize or set variables. This is because the release condition can be evaluated many times before a job is executed, causing all expressions in the release condition to be executed multiple times before the task actually is released, or started. For this reason, you should not use the release condition to increment variables. These sorts of expressions should be placed in the beginning effect.

❖ Beginning Effect. This field contains optional expressions indicating what happens when the task begins execution. These expressions might be as simple as setting new values for one or more variables in your model, or they could be much more complicated expressions.
Once the beginning effect occurs, the task execution time is calculated. As the beginning effect is evaluated, the corresponding node in the network diagram highlights if the node is visible in the network diagram. Lastly, once all code in the beginning effect code box has been evaluated, any snapshots which were set to trigger on the execution of this task will be taken.

You can use beginning effects with tactical decision branching. When a task is specified as having more than one following task with a tactical decision type, tactical expressions are used to specify which route is taken. The variables in the tactical expressions can be assigned different values in beginning or ending effects of other tasks to establish the true condition for the tactical decision. To view variables, double-click **Variables** below the mission you are defining in the Analysis Tree. A list of Variables will display. Click a variable in the list to display its properties in the Properties dialog box.

For details on return statements, see Return Statements in *IMPRINT Pro Syntax Reference Manual*, Volume. 3 of *IMPRINT Pro User Guide*.

- **Ending Effect.** This field contains expressions indicating what happens when the task finishes execution.

  To set an ending effect for a task, double-click the task, click the Effects tab at the top of the task dialog, and enter the desired expression(s).

  You may access Variables to aid in specifying any effects. To view Variables, double-click **Variables** below the mission in the Analysis Tree. A list of variables will display. Click the individual Variable to display the properties in the Properties dialog box.

**Task Information Dialog Box – Failure Tab**

IMPRINT Pro provides several possible consequences of task failure due to accuracy from which you can choose. These include:

- Changing the time or accuracy on another task.
- Changing the following task.
- Causing the mission to abort, which is reported as an accuracy failure.
- No effect.
Chapter 5: Mission Analysis

- Changes the operator assigned to a task.
- Task repeats.

Probabilities are assigned to each of these consequences to control which ones are likely to be exercised in the event a task fails. If a task does fail during a model run, IMPRINT Pro pulls a random number from its stream and compares it to the probabilities entered to determine which failure consequence it must implement.

**Note:**
If you choose to use the effect that assigns a different following task in the event of failure (such as choice 2 on the Failure Tab), make sure that you do not assign a rejoin task as the new following task. This will cause the model to run incorrectly. For more information about Multiple decision type, see Decision Type in the “Task Information Dialog Box – Paths Tab” on page 157.
Task Information Dialog Box – Crew Tab

When you click the Crew tab you will see two columns as follows:

- **Warfighter Name.** Shows the list of Warfighters that are added to your analysis when you populated your IMPRINT Pro Warfighters node.

  For details on defining Warfighters, see “Warfighter Data” on page 67.

- **Assignment.** For each task, you must identify a Primary Operator. You may optionally identify one or more Contingency Operators as well. Each task can only have one primary Warfighter assignment, but can have a maximum of six contingency Warfighters. Contingency Warfighters will perform the task in the event that the primary Warfighter experiences workload overload. The workload management strategies, discussed in “Operator Workload Management Strategies” on page 74 describe how this works.

<table>
<thead>
<tr>
<th>Time and Accuracy</th>
<th>Effects</th>
<th>Failure</th>
<th>Crew</th>
<th>Taxons</th>
<th>Paths</th>
<th>Workload Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warfighter Name</td>
<td>Assignment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#1 Recon Crewman</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2 Recon Crewman</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commander</td>
<td>Primary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gunner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Task Information Dialog Box – Taxons Tab

Tasks can be broken down into a separate set of categories called Taxons. This categorization is used to describe the workload composition of your task in a way that PTS moderators can utilize when the conventional workload definitions cannot. When taxons are applied to a task, they are used by IMPRINT Pro to adjust estimated task times and accuracies as appropriate whenever Personnel Characteristics, Training Frequency or Stressor adjustments are applied.

The taxons are grouped into four areas. These four taxon categories are:
Perceptual
Cognitive
Motor
Communication

Taxons are assigned weight values ranging from 0.0 to 1.0. At most, three taxon weights can be used at a time, the sum of which must be 1.0. At the bottom of the screen, the total of the weight values is labeled **Total Weight**. IMPRINT Pro automatically adds the taxon weight values as you enter them. Click in the box to see the total.

Mapping Workload Values to Taxons

In earlier versions of IMPRINT (IMPRINT 7) only certain types of models (Goal Orientation and VACP) were able to have assigned taxons in order to exercise PTS moderators. Advanced models were excluded from this functionality. In IMPRINT Pro, all models can now have assigned taxon values and take advantage of the PTS Moderators option.
You may choose your own taxons for the tasks and enter your own taxon weights manually (as mentioned in the section above) or you may map existing workload demand values to taxons automatically. When mapping values automatically, however, it should be noted that each task is allowed only three taxon weights. In the event a task has more than three workload channels to which workload is assigned, all of which might map to different taxons, only the three highest workload scores will be chosen for taxon mapping. Once the selected workload channels are mapped to taxons, the three workload demand values are summed and normalized, determining the proportional weights of these corresponding taxons.

IMPRINT Pro maps the following workload channels and their corresponding demand values to taxons as shown in the table below:

<table>
<thead>
<tr>
<th>Workload Demand Value</th>
<th>Taxon Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Visual without night vision goggles</strong></td>
<td></td>
</tr>
<tr>
<td>3.0 - Visually Register/Detect</td>
<td>All Visual workload scores (without night vision goggles) EXCEPT for Visually Read (see below) map to Visual Recognition/Discrimination.</td>
</tr>
<tr>
<td>3.0 - Visually Inspect/Check</td>
<td></td>
</tr>
<tr>
<td>4.0 - Visually Locate/Align</td>
<td></td>
</tr>
<tr>
<td>4.4 - Visually Track/Follow</td>
<td></td>
</tr>
<tr>
<td>5.0 - Visually Discriminate</td>
<td></td>
</tr>
<tr>
<td>6.0 - Visually Scan/Search/Monitor</td>
<td></td>
</tr>
<tr>
<td>5.1 - Visually Read</td>
<td>Communication - Read and Write</td>
</tr>
<tr>
<td><strong>Visual with night vision goggles</strong></td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>Workload scores for Visual with night vision goggles are generally higher than those for Visual without night vision goggles. However, this scale does not have a scale benchmark for reading. Therefore all Visual with night vision goggles scores map to Visual Recognition/Discrimination.</td>
</tr>
<tr>
<td><strong>Auditory</strong></td>
<td></td>
</tr>
<tr>
<td>1.0 - Detect/Register Sound</td>
<td>Does not map any taxon.</td>
</tr>
<tr>
<td>2.0 - Orient to Sound (general)</td>
<td></td>
</tr>
<tr>
<td>4.2 - Orient to Sound (selective)</td>
<td></td>
</tr>
<tr>
<td>4.3 - Verify Auditory Feedback</td>
<td></td>
</tr>
<tr>
<td>Workload Demand Value</td>
<td>Taxon Mapping</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>3.0 - Interpret Semantic Content (speech) Simple (1-2 words)</td>
<td>Communication - Oral</td>
</tr>
<tr>
<td>6.0 - Interpret Semantic Content (speech) Complex (sentence)</td>
<td></td>
</tr>
<tr>
<td>6.6 - Discriminate Sound Characteristics</td>
<td></td>
</tr>
<tr>
<td>7.0 - Interpret Sound Patterns</td>
<td></td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td></td>
</tr>
<tr>
<td>1.0 - Automatic (simple association)</td>
<td>All values below 7.0 map to Information Processing/Problem Solving</td>
</tr>
<tr>
<td>1.2 - Alternative Selection</td>
<td></td>
</tr>
<tr>
<td>3.7 - Sign/Signal Recognition</td>
<td></td>
</tr>
<tr>
<td>4.6 - Evaluation/Judgement (single aspect)</td>
<td></td>
</tr>
<tr>
<td>5.0 - Rehearsal</td>
<td></td>
</tr>
<tr>
<td>5.3 - Encoding/Decoding, Recall</td>
<td></td>
</tr>
<tr>
<td>6.8 - Evaluation/Judgement (several aspects)</td>
<td></td>
</tr>
<tr>
<td>7.0 - Estimation, Calculation, Conversion</td>
<td>Numerical Analysis</td>
</tr>
<tr>
<td><strong>Fine Motor</strong></td>
<td></td>
</tr>
<tr>
<td>2.2 - Discrete Acuation (button, toggle trigger)</td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td>2.6 - Continuous Adjustive (flight control, sensor control)</td>
<td>Fine Motor Continuous</td>
</tr>
<tr>
<td>4.6 - Manual (tracking)</td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td>5.5 - Discrete Adjustive (rotary, vertical thumb wheel, lever position)</td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td>6.5 - Symbolic Production (writing)</td>
<td>Communication - Read and Write</td>
</tr>
<tr>
<td>7.0 Serial Discrete Manipulation (keyboard entries)</td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td>Other user values</td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td><strong>Speech</strong></td>
<td></td>
</tr>
</tbody>
</table>
When mapping to tasks automatically, you may choose to map workload scores for all tasks in your model at once, or you may map them individually on a task by task basis.

**To Map Workload Values to Taxons by Individual Task:**

1. Enter the workload demand values for your task under the **Workload Demand Tab** in the Task Information dialog box.

2. Click the **Taxons** tab.

3. At the bottom of the tab, click the **Map Workload Values** button.

   Taxon weights corresponding to your task’s workload scores appear.

The number of taxons you may have in any one task is limited to three. If a task in your network contains more than three workload demand values, the three largest workload demand values are chosen for taxon mapping. These values are then normalized to a sum of 1.0

---

<table>
<thead>
<tr>
<th>Workload Demand Value</th>
<th>Taxon Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 - Simple (1-2 words)</td>
<td>All Speech values (including user defined) map to Communication - Oral</td>
</tr>
<tr>
<td>4.0 - Complex (sentences)</td>
<td></td>
</tr>
<tr>
<td><strong>Gross Motor</strong></td>
<td></td>
</tr>
<tr>
<td>1.0 - Walking on Level Terrain</td>
<td>Gross Motor Light</td>
</tr>
<tr>
<td>2.0 - Walking on uneven terrain</td>
<td></td>
</tr>
<tr>
<td>3.0 - Jogging on Level Terrain</td>
<td>Gross Motor Heavy</td>
</tr>
<tr>
<td>3.5 - Heavy Lifting</td>
<td></td>
</tr>
<tr>
<td>5.0 - Jogging on Uneven Terrain</td>
<td></td>
</tr>
<tr>
<td>6.0 - Complex Climbing</td>
<td></td>
</tr>
<tr>
<td><strong>Tactile</strong></td>
<td></td>
</tr>
<tr>
<td>1.0 - Alerting</td>
<td>Does not map to any taxons.</td>
</tr>
<tr>
<td>2.0 - Simple Discrimination</td>
<td></td>
</tr>
<tr>
<td>3.0 - Complex Symbolic Information</td>
<td></td>
</tr>
</tbody>
</table>
To Map Workload Values to Taxons Globally (all tasks):

1. Enter the workload demand values for all tasks under the Workload Demand Tab in the Task Information dialog box.

2. From the Moderators menu, choose the Map Workload to Taxons option.

   A dialog box appears reminding you that all tasks with workload demand values but without taxons will have their demand values mapped to taxons.

3. Click the Ok button.

4. Workload scores for all tasks in the network map to taxon values. In the Taxons tab for each task, all applicable taxon categories are checked, and their corresponding taxon weights appear in the Taxon Weight fields.

   ✓ Note:
   All tasks whose workload demand values were previously mapped to taxons will not be affected by this action.

   The Output window displays a summary of the tasks whose values were mapped.
Workload Mapping Example

1. Assume a given task has the following workload assigned:
2. Choose the option to map workload scores, either by clicking the **Map Workload Values** button on the task’s **Taxons** tab or by choosing the **Map Workload to Taxons** option through the **Moderators** menu. IMPRINT Pro allows a maximum of three workload scores to be mapped to taxons. In our example above, the Fine Motor 2.6 Continuous Adjustive score is omitted.

3. The remaining workload scores are mapped to taxons as follows:
4. Workload scores are totalled:

\[ 4.0 + 6.0 + 7.0 = 17.0 \]

5. Taxon weights are calculated by normalizing the workload scores:

The taxon mapping weight for Visual Recognition/Discrimination:

\[ 4.0 \div 17.0 = 0.24 \]

The taxon mapping weight for Communication - Oral:

\[ 6.0 \div 17.0 = 0.35 \]

The taxon mapping weight for Numerical Analysis:

\[ 7.0 \div 17.0 = 0.41 \]
Chapter 5: Mission Analysis

Task Information Dialog Box – Paths Tab

The Paths tab contains the Decision Type and Decision Code describing the conditions under each of the individual paths leaving a task are taken.

IMPRINT Pro uses three different decision types: Tactical, Probabilistic, or Multiple. The decision type determines the path or paths that an entity should take. A decision node displays in the network diagram as a diamond-shape on the end of a task node and contains a letter inside of it (T, P, or M) indicating the type of decision.

Decision nodes are automatically added to a task by IMPRINT Pro. Whenever a task has more than one possible path emerging from it, the logic for the Decision code determines the paths that the entity takes.
**Decision Type.** Displays the type of decision. Available types are:

**Multiple.** All of the following paths begin execution simultaneously following execution of the current task. When this happens, the entity exiting the current task splits into copies of itself, each following one of the paths. In some instances of Multiple branching logic, however, it is important to make sure that all branched entities eventually merge back into one single entity at a rejoin node before reaching the End task of the model. For more information see "Merging Split Entities" on page 168.

In Multiple branching, you may repeat a task back onto itself by drawing a path from the task’s decision diamond to the center of the node - a new path appears as a loop above the node in the network diagram, and a new code box appears in the Paths tab in the Task Information dialog box. This path will continue to loop back to this same task until this path’s code no longer evaluates to true.

The default decision type for a single path exiting a task is a Multiple decision type.
Probabilistic. In the case of a Probabilistic node, more than one path might be linked to the current task, but only one of those paths may execute after the current task is completed. The likelihood of a path executing next is determined by a probability value that is set for this particular path in the current task’s routing conditions. The probability that a particular path follows is equal to its probability value in the Decision Code field divided by the sum of the probability values of all possible following paths.

Example: If the probability value is 25 percent for path A, you could enter .25, 1, or 25 in the Decision Code for path A and enter .75, 3, or 75 respectively, for the Decision Code for path B.

The likelihood of a task is taken as a ratio of the sum of the value for all tasks.

Tactical. The path with the tactical expression that evaluates to the highest value executes next; you supply the tactical expression as the routing condition.

In Tactical branching, you may repeat a task back onto itself by drawing a path from the task’s decision diamond to the center of the node - a new path appears as a loop above the node in the network diagram, and a new code box appears in the Paths tab in the Task Information dialog box. This path will continue to loop back to this same task provided this path’s code evaluates to the highest value among all paths.
Note:
In Tactical decision branching, if all paths evaluate to true, the path drawn first is the path that is taken. If all paths evaluate to zero or false, one path must still be taken, namely the one that was drawn first.

Decision Code. Contains the conditions under which particular paths are taken. You can express the routing condition as a number or an expression. The number and name of the next task to be executed when the routing conditions are met display above the Decision Code box. You must include a return statement in the expressions defining the decision code.


Task Information Dialog Box – Workload Demand Tab

Workload demand values are entered based upon the nature of the demand. These values will be used to compute the first order workload components during model execution. The values should indicate the relative demand on each channel when performing a task.

Prior to entering workload demand values, however, you must first add your resources and interfaces, determine the resource-interface (RI) pairs and then assign the applicable workload value to each of these pairs for the given task. For more information on creating RI pairs, see “Defining Resource-Interface Channels” on page 197.

The Workload Demand dialog box displays two tabs: Interfaces and Values. In the Interfaces tab, you first check the boxes corresponding to the interfaces which apply to your task, for example “Radio” and “Steering Wheel”. This action then filters the Values tab to display workload boxes for only those RI channel pairs whose interfaces you selected, for example “Auditory-Radio” and “Fine Motor-Steering Wheel”. In these boxes you may then enter the desired workload amounts for each channel your task requires.
By default, each task includes a starting interface called “Crewstation”, but you may choose to create your own interfaces in the Analysis Tree.

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time and Accuracy</td>
<td></td>
</tr>
<tr>
<td>Effects</td>
<td></td>
</tr>
<tr>
<td>Crew</td>
<td></td>
</tr>
<tr>
<td>Taxons</td>
<td></td>
</tr>
<tr>
<td>Paths</td>
<td></td>
</tr>
<tr>
<td>Workload Demand</td>
<td></td>
</tr>
</tbody>
</table>

Interfaces used for this Task:
- CrewStation

Once the interfaces appropriate to your task are checked, click the **Values** tab. A worksheet displays, showing all applicable resource-interface channels in the first column to the left. Demand values corresponding to these resource-interface channels display in the adjacent cells under the **Demand Value** column. Any demand values previously entered are displayed in the cells. The default demand value is zero. The worksheet scrolls left and right and up and down if necessary.
If the channel involves one of the seven default resources (Auditory, Cognitive, Fine Motor, Gross Motor, Speech, Tactile and Visual) then demand value may be entered automatically.

**To enter Automatic Task Demand Values:**

1. Under the **Demand Value** column, click the cell corresponding to the RI-pair whose demand value you wish to set.

2. Click the **Auto** button to the right of the dialog box. This button displays as “...”.

   The **Automatic Task Demand Value** dialog window opens. This window displays a scale of workload amounts from which to choose.

3. From the list of available demand values, select the one whose workload value and description most accurately reflects the workload required by this task. For more information, see **Task Demands**.
4. Click the automatic task demand value that best indicates the relative demand on the channel when performing the task, and then click OK.

The value appears in the Demand Value cell for that RI-pair in the Workload tab.

Alternatively, you may cancel out of the Demand Value dialog without selecting a demand value:

- Click Cancel to return to the Workload Demand tab. The Demand Value will remain unchanged with no new Demand Value entered in the Workload Demand dialog box.

- Click the X in the upper right hand corner of the Automatic Task Demand Value dialog box.

✓ Note:
If you defined resources in addition to the default resources, you will not have the automatic entry option. To enter a demand value manually, click once in the demand field and use the numeric, backspace, and delete keys to manually enter a value.
Editing Tasks

To edit a task:

1. To display the Task Description dialog box, do one of the following:
   - On the network diagram, double-click the task.
   - Double-click the Task node in the Analysis Tree.

   The Task Description dialog box appears in the main IMPRINT Pro window, displaying all properties of this task. These same properties also display in the Properties window.

2. Edit the properties in the Task Description dialog box or Properties window as desired.

   For details on task properties, see “Task Information” on page 184.

Deleting Tasks

To delete a task:

Do one of the following:

- Right-click the task in the Analysis Tree, and then select Delete Task from the menu that displays.
- Right-click the task on the network diagram and select Delete Task from the menu that displays.
- Select the task, and then press the Delete key on the keyboard.

The task is removed.

✓ Note:
When you select an network object, a green box displays around the item.

Copying Tasks

To copy a task:

Do one of the following:

- On the Network Diagram, right-click the task, and then select Copy Task from the menu that displays.
- In the Analysis Tree, right-click the task, and then select Copy Task from the menu that displays.
- Select the task, and then select Copy from the Edit menu.
• Select the task, and then click the **Copy** button on the tool bar.

The selected task copies to the Windows clipboard. Once a task is copied, it can then be pasted into another function or network diagram in IMPRINT Pro.

**Cutting Tasks**

*To cut a task:*

Do one of the following:

• Right-click the task on the Network Diagram or and then select **Cut Task** from the menu that displays.

• Right-click the task in the Analysis Tree, and then select **Cut Task** from the menu that displays.

• Select the task, and then select **Cut** from the **Edit** menu.

• Select the task, and then click the **Cut** button on the tool bar.

The cut task appears highlighted in red in the Analysis tree. Once the cut task is pasted into another function or Network Diagram, IMPRINT Pro removes the task from its current location and adds it to the new location.

**Pasting Tasks**

*To paste a task:*

Copy or cut the task and do one of the following:

• Right-click the network diagram and select **Paste Node(s)** from the menu that displays.

• Right-click in the Analysis Tree, and select **Paste Node(s)** from the menu that displays.

• Select the Function or Network Diagram to which you want to paste the task, and then select **Paste** from the **Edit** menu.
• Select the Function or Network Diagram to which you want to paste the task, and then click the **Paste** button on the tool bar.

The task appears in the selected network diagram and in the tree. If you used the Cut command, the cut task will be removed from its previous location once pasted to its new location.

**Note:**
If you are pasting the task to a network inside a different analysis, the Task Data Mapping dialog box will display. For more information on how to use the Task Data Mapping dialog, see “Pasting Objects to Mission Model or Analysis” on page 100.

---

### Dummy Nodes

Sometimes it is convenient to use dummy nodes to clarify the flow of your mission. These dummy nodes can be either functions or tasks that will act as placeholders in the function or task list and in the sequence. If you add a dummy function, you must also add dummy task to that function. By not assigning times to these nodes, they will not take any time in the mission simulation model and thus will not have an impact on mission time. It is for this reason that some of the functions and tasks in the library models have a performance time estimate of 0.

### Single, Multiple and Splitting Entities

The flow of any model is determined by the types, order and duration of the nodes defining it. For basic models, it is easy to picture this flow in the network diagram. More complex models, however, may have nodes which repeat or have multiple instances fire at the same time. To keep track of all these instances, it is helpful to use the concept of “entities.”

An “entity” is an imaginary element which flows through a network of tasks, the location of which describes the task in the network whose release condition, beginning effect or ending effect is currently being evaluated. Although tasks and functions in your model are driven by the order and duration you set for the individual tasks and functions in the model, it is sometimes easier to think of the flow of the model as a series of functions and tasks through which an imaginary element, or “entity”, travels. For example, directions from a house to the local store could be viewed as a distinct set of turns, straightaways and stoplights along a series of streets and highways. The streets and highways in this example are analogous to the tasks and functions added to the model and their distances analogous to function and task durations. The straightaways, turns and stops are similar to the paths in your network. To pinpoint the exact location along
the route being traveled at the current time, however, is much easier to conceptualize by imagining a car following the exact route of streets and highways, guided by the turns and stoplights prescribed. Similarly, an entity may also be thought of as the marker in the model indicating which task is currently being exercised in the model, guided by the path logic and code added.

Any model can be designed to use a single entity, multiple entities or splitting and merging entities.

- **Single Entity.** Models comprised of simple networks that lead an entity though a simple chain of tasks and functions from Star to End will most likely have a single entity flowing through them. These types of models do not contain repeating or spinning tasks, multiple branching, External Events or Model.Start calls anywhere in the model. To illustrate this using the driving example above, we can picture a single car starting at the initial location which follows a simple series of streets to its ultimate destination.

- **Multiple Entities.** Multiple entities can be found in any model in which two or more tasks in a network are active at the same time. While the first entity might originate at the Start node of the model during model execution, the second entity (or any other additional entity) could be started at any point during the model run using an External Event, a looping task or Model.Start command from another node in the model. In the car example above, in addition to the original car on the route, several additional cars are added to the route and will drive along some of the exact same streets as the first node, just as multiple entities might enter the same exact tasks as the first entity. These cars might start at the beginning of the route as well or might instead pop up in the middle of the route at a particular time.

- **Splitting and Merging Entities.** The most common occurrence of a splitting entity in a model is when a node splits off into multiple paths, and the “Multiple” path logic is followed. In this case, the entity leaving the original node then splits into several copies of itself to follow all branching paths. It is important to note, however, that splitting entities which are generated this way are different from the multiple entities mentioned above which generate “additional” entities through loops, Model.start commands and External Events, namely because any entity which splits at a branch must eventually merge back into one branch again at a later point in the model. The point at which the branches rejoin is referred to as the “rejoin node,” the location at which the split entities would ideally merge.
Using the car example above, assume a car has a driver and three additional passengers. This car travels along the prescribed route in a neighbourhood, just as an entity would follow a path in a network. A decision is made, however, to stop the car at the local shopping mall where the driver goes into the grocery store for a gallon of milk, the first passenger goes into the post office to deliver a package, the second passenger picks up some coffee at the local cafe and the third picks up the dry-cleaning. The single car full of people splitting up into four separate parties each running an errand represents the single entity splitting into four partial entities at a Multiple branch decision node. Just as each person in the group is capable of completing different errands at the shopping mall by his/herself, each of the partial entities along the multiple paths are all capable of completing separate tasks and advancing the simulation clock. Furthermore, just as all four passengers should wait at the car for everyone to return before continuing on the road, all partial entities flowing through the separate branches of the Multiple branch of a network should wait before the release condition of the rejoin node in order that all split entities may eventually merge back into a single entity. Once all entities from the original split have merged, the merged entity may continue on through the rest of the network. For more information see “Merging Split Entities” on page 168.

**Merging Split Entities**

Merging split entities at a rejoin node can be done two different ways:

**To Merge Split Entities using Multiple Variables:**

1. Define a unique variable for every branch exiting a defined Multiple decision node in your network. For example, in the case of a decision node splitting into two branches, define two variables named A and B.

2. In the ending effect of the last task in the first branch connecting to the rejoin node, add the following statement:

   \[ A=1; \]

3. In the ending effect of the last task in the second branch connecting to the rejoin node, add the following statement:

   \[ B=1; \]
4. Finally, in the release condition of the rejoin task, add the following statement:

```c
return (A==1 && B==1);
```

This statement ensures that the rejoin node starts only after both branches have finished. By suspending the release of the rejoin node until both branches have finished, both split entities are able to meet together and merge joining the two paths back to a single task, the entities merge into one entity again.

**To Merge Split Entities using a Decrementing Variable:**

1. Define a unique integer variable, for example variable A.

2. Set the initial value of A to the number of branches exiting the Multiple Decision node where the entity first splits. For example, if three tasks branch from a single task, set the initial value of Variable A to be 3.

3. In the ending effect of the last task in the first branch connecting to the rejoin node, add the following statement to decrement the value of A by one:

   ```c
   A--;
   ```

4. Repeat step 3 above until this statement appears in the Ending Effect of the last task in each branch connecting to the rejoin node.

5. In the Release Condition of the rejoin node, add the following statement:

   ```c
   return (A==0);
   ```

Each path, upon finishing, decrements the value of A by one. Once the third and final path has finished out, the value of A will have been reduced three times and become 0. It is at this point where all three entities, waiting in front of the release condition of the rejoin node, are merged into one entity which then flows into the rejoin node task.
Tagging Entities

Entity Tagging is a method used to uniquely identify one or more entities in your model. A tag is an attribute assigned to an entity, much like a license plate is assigned to a car or a social security number is assigned to a person. By tagging entities, each entity can be followed throughout the model as it runs. Furthermore, a model can be designed to perform specific actions on specific entities or can cause an effect in a task (release condition, beginning effect or ending effect) to occur as a result of a specific tagged entity passing through.

As multiple entities flow through a model, it is possible that they can all flow through separately if the model is specifically designed to allow this. In cases where more entities are untagged and waiting in front of the same release condition (waiting for it to turn true), the entities will instead be merged together as one single entity before entering the beginning effect of this task. By tagging the entities earlier in the model, entities will retain their unique identification throughout the model run provided no other entity is assigned the same exact tag value elsewhere in the model.

By default, the first entity to run through the model during execution is assigned a tag value of 0. Tagging subsequent entities requires the following steps be followed:

1. Identify the location in the model where multiple entities are likely to be generated, such as a task looping back on itself while simultaneously branching off to a subsequent task, using the Multiple path logic. In this case, since both paths are taken the original entity will pass through to the next task while a new entity is generated and passes back through the start of the original task.

2. Determine the phase of that task where the unique identification of the entity must be set. In our looping example, the entity tag value can be changed either in the beginning effect or the ending effect of the task.
3. Increment the tag value. To the desired effect of the task, add the following statement:

    Entity.tag++;

Where “.tag” refers to the attribute of the entity passing through and “++” implies that the value of the tag assigned to the entity should be incremented by 1. After the entity passes through this task, its tag value is unique to the entity which passed through before it.

To illustrate entity tagging, consider the example below where airline passengers arrive at the airport and must go through security screening before proceeding to the gate. The first image below demonstrates the process for a single passenger:

To create multiple passengers in the model, multiple entities must be created in the “Passenger Arrives at Security Checkpoint” task. To create these multiple entities, create a loop from the end of this task back onto itself.

Since the task now has two paths leaving it, the decision diamond displays an “M” indicating “Multiple” path logic meaning any entity leaving the task will take both paths. Because the same entity must take both paths, however, it must create a new copy of itself (a new entity, but with an identical tag value) to follow the path back to the original task while it also takes the path. Until entities are uniquely tagged, however, all entities will share the same default tag value of 0 and could potentially merge further down in the model. To prevent this accidental merging of entities, open the Effects tab of the task, and add the command “Entity.Tag++;” to the ending effect of this task.
Any task entering and leaving this task will automatically have its tag value incremented by one. The first entity to pass through this task in the model, with a default tag value of 0, will automatically be assigned a tag value of 1. As the entity splits at the multiple node, one instance of itself (tag value of 1) passes along to the next task, “Passenger Directed.” Meanwhile the second instance of this entity (also has a tag value of 1) returns back to the “Passenger Arrives at Security Checkpoint” task. This time as the task passes through, its tag value is incremented by one again, and it leaves with an entity tag value of 2. Each uniquely tagged entity can then be tracked throughout the model by monitoring the entity tag value.

**Goals**

By adding goals, you can model possible mission interruptions and the additional workload Warfighters may experience. Adding goals allows you to:

- Identify goals that may or may not conflict with the main mission
- Set initiating conditions to initiate goals
Prioritize goals

Build task network models representing goals that run when goals are activated/encountered

Specify each goal’s impact on the mission and other goals

Adding Goals

Goals orientation logic can be added to the uppermost level of your mission. Goals are placed on the network diagram but do not connect to functions or tasks in your mission.

To add a goal:

Do one of the following:

• Right-click the Network node in the Analysis Tree, and then select Add Goal from the menu that displays.

• From the task network palette, drag the Goal object to the network diagram.

• Right-click the network diagram, and then select Add Goal from the menu that displays.

The new goal displays in the network diagram.

Note: IMPRINT Pro will name your new goal Goal. If you continue to add goals, each following goal will be named GoalX where X is the next integer. You can edit the name of the goal in the Name field in the Goal Properties dialog box.

Note: IMPRINT 7 models whose mission types changed from Goal-Orientation to Advanced prior to import will potentially import into IMPRINT Pro with goals attached. This will occur if any goals remained before the mission type was changed. Once imported into IMPRINT Pro, these goals may then be deleted as required.

Displaying Goal Properties

To display the goal properties:

Double-click the goal object in the Analysis Tree.

A Goal Properties window displays.
The top of the Goal Information window lists the ID, name and description of your chosen goal.

```
ID: 1
Goal Name: Goal1
Description: This goal simulates an incoming cell phone call.
```

The Goal Properties window also displays three separate tabs:

- **Info.** Basic information about your goal, including Priority, impact on Mission, Time Requirement and Criterion, displays in this window.
- **Initiating Condition.** Enter code in the Initiating Condition tab to determine the triggering of this goal. A goal fires when its initiating condition evaluates to True.
- **Goal Actions.** Select the effect this goal has on other goals in your mission. Options include **Abort**, **Interrupt** and **Nothing**.

```
<table>
<thead>
<tr>
<th>Info</th>
<th>Initiating Condition</th>
<th>Goal Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority: 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mission Running: Interrupt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Requirement: 00:10:00.00 HH:MM:SS:mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Criterion: Goal must meet time requirement 90.00% of the time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workload Management Suspended</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

**Goal Properties - Info Tab**

The Info tab contains the following fields:
Priority. A number assigned to a goal to determine its priority relative to other goals. You may set a higher priority goal to abort or interrupt a lower priority goal.

Mission Running. The value in this field determines the impact that this goal has on the current mission. You may designate that the goal may interrupt or do nothing to the mission.

Time Requirement. This value is the maximum acceptable performance time for this goal.

Criterion. This value is the percentage of times that this goal must meet its time standard to be considered successful.

Workload Management Suspension. This flag controls whether or not a workload strategy is suspended in if an operator who is currently working on a task is interrupted by a goal whose workload amount would put him or her in an overload situation. For example if an operator were driving a car and a cell phone call (represented by a goal function) occurred, there is a possibility that the total workload incurred by driving and answering the call would put the operator in an overload condition. By setting the Workload Management Suspension flag to True, the management strategy assigned to the operator is suspended, and the operator continues to do both tasks in the overloaded state. By setting the Workload Management Suspension flag to false, the management strategy you choose is allowed to take over to prevent the operator from continuing in an overloaded state.

Goal Properties - Initiating Condition Tab

The Initiating Condition tab contains the following field:
Initiating Condition. The initiation condition field allows you to define trigger conditions for initiating goals. Examples of trigger conditions are that performance is out of line with desired criteria; workload levels approach severe; or some other external condition. These trigger conditions must be represented by expressions in this field.

Goal Properties - Goal Actions Tab

The Goal Actions Tab contains the following fields:

<table>
<thead>
<tr>
<th>Other Goal Name</th>
<th>Priority</th>
<th>Goal Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal2</td>
<td>1</td>
<td>Nothing</td>
</tr>
<tr>
<td>Goal3</td>
<td>2</td>
<td>Interrupt</td>
</tr>
</tbody>
</table>

- **Other Goal Name.** This is the name of another goal in your mission upon which your selected goal will act.

- **Priority.** This is the current priority assigned to the listed goal. The lower the number, the higher the priority, for example a goal with a priority of 1 has a higher priority than a goal with a priority of 5.
Goal Action. This is the action which your selected goal will take on the listed goal. Options include Interrupt, Abort and Do Nothing.

Editing Goals

You can edit the goal in the Goal information dialog box or Properties window.

To edit a goal:

1. In the Analysis Tree, below the Network node, double-click the goal.

   The Goal dialog box displays in the main window, displaying properties of this goal. The Properties window also updates to display the same information.

2. Make changes in the Goal dialog box or Properties window as desired.

Deleting Goals

Using the delete command to will delete the goal and all its associated date from the mission.

To delete a goal:

Do one of the following:

- Select a goal in the Network Diagram or the Analysis Tree, and then press the Delete key on the keyboard.
- Right-click the goal in the Analysis Tree, and then select Delete Goal from the menu that displays.
- Right-click the goal on the network diagram, and then select Delete Goal from the menu that displays.

The goal is removed.

Copying Goals

A goal and all its associated data can be copied and pasted into another network.
To copy a goal:

Do one of the following:

- Right-click the goal on the network diagram, and then select **Copy Goal** from the menu that displays.
- Right-click the goal in the Analysis Tree, and then select **Copy Goal** from the menu that displays.
- Select the goal in the Network Diagram on in the Analysis Tree, and then click the **Copy** button on the tool bar.
- Select the goal on the Network Diagram or the Analysis Tree, and then select **Copy** from the **Edit** menu.

The goal and all its associated data will be added to the Windows clipboard.

Cutting Goals

To cut a goal:

Do one of the following:

- Right-click the goal on the Network Diagram, and then select **Cut Goal** from the menu that displays.
- Right-click the goal in the Analysis Tree, and then select **Cut Goal** from the menu that displays.
- Select the goal in the Network Diagram or the Analysis Tree, and then click the **Cut** button from the tool bar.
- Select the goal in the Network Diagram or the Analysis Tree, and then select **Cut** from the **Edit** menu.

The cut goal highlights in red. When you paste the goal into another network, IMPRINT Pro removes the goal from its current location and pastes it to the new location.

Pasting Goals

To paste a goal:

Copy or cut the goal and do one of the following:

- Right-click the network diagram, and then select **Paste Node(s)** from the menu that displays.
- Right-click in the Analysis Tree, and then select **Paste Node(s)** from the menu that displays.
- Select the Network Diagram into which you want to paste the goal, and then select **Paste** on the **Edit** menu.
• Select the Network Diagram into which you want to paste the goal, and then click the **Paste** button on the tool bar.

The goal appears in the selected Network Diagram and in the Analysis Tree under the node corresponding to that network. If you used the Cut command, the cut goal will be removed from its previous location.

**Note:**
If you are pasting the goal to a network node in a different analysis, the Task Data Mapping dialog box will display. For more information on how to use the Task Data Mapping dialog, see “Pasting Objects to Mission Model or Analysis” on page 100.

### Adding Functions to Goals

When you build a goal network, it will have its own separate subnetwork. You can add functions, tasks, and comments to the subnetwork.

**To add a function to a goal:**

Do one of the following:

• Right-click the goal on the network diagram to which you want to add a function, and then select **Add Function** from the menu that displays.

• Right-click the goal in the Analysis Tree to which you want to add a function, and then select **Add Function** from the menu that displays.

• Open the goal network diagram, select the function object on the Palette, and drag it to the goal network diagram.

A new function appears below the goal in the Analysis Tree and in the goal diagram.

### Adding Tasks to Goals

By default, every goal contains a Start task and an End task in its subnetwork. Additional tasks may be added as needed.

**To add a task to a goal:**

Do one of the following:

• Right-click the goal on the network diagram to which you want to add a task, and then select **Add Task** from the menu that displays.

• Right-click the goal in the Analysis Tree to which you want to add a task, and then select **Add Task** from the menu that displays.
• Open the goal network diagram, select the task object on the Palette, and then drag it to the goal network diagram.

A new task appears below the goal in the Analysis Tree and in the goal diagram.

When adding new tasks to your goal subnetworks, it is important to keep in mind that the End task of the goal (the “999” task) should be the last task in the subnetwork to finish. If one or more tasks in the subnetwork are started remotely by a Model.Start command from within an effect of another task, it is possible these tasks might not end prior to the 999 End task unless configured to do so. To ensure that the subnetwork of any goal in your network having these kinds of tasks ends gracefully, the following steps are recommended:

**To end goals having remotely-started tasks:**

1. Add a new boolean variable, for example, "goalended".

2. In the Ending Effect of the task that starts remotely, add the following code:

   ```
   goalended == true;
   ```

3. In the Release Condition of the End task, add the following code:

   ```
   Return goalended == true;
   ```

   The End task of the goal subnetwork is released when the value of the variable is true. This will only happen when the remotely-started task has already finished.

**Adding Comments to Goals**

Comments can be used to add headers for clarification, add other text to the diagram, and to display values of variables for display on the network diagram during the model run.

**To add a comment to a goal:**

Do one of the following:

• Right-click the goal on the network diagram to which you want to add a comment, and then select Add Comment from the menu that displays.
• Right-click the goal in the Analysis Tree to which you want to add a comment, and then select **Add Comment** from the menu that displays.

• Open the goal network diagram, select the comment object on the Palette, and then drag it to the goal network diagram.

A new comment appears below the goal in the Analysis Tree and in the goal diagram.

### Review Goals, Functions and Task Data

IMPRINT Pro collects data from Goals, Functions and Tasks and summarizes this information in worksheets. You can view the worksheets by double-clicking the **Network** node in the Analysis Tree.

**To display Review Goals, Review Function and Review Tasks:**

1. Double-click the Network node below a mission in the Analysis Tree.

   A Review dialog box displays in the main window, and includes three tabs: Review Goals, Review Functions, and Review Tasks.

2. To view a particular window, select the corresponding tab at the top.

### Review Goals

The purpose of this worksheet is to enable you to view all the goal data in a tabular format. These data are sorted in order of increasing goal function numbers. The worksheet scrolls left and right so that you can view all the columns. In addition, you can change the widths of individual columns by dragging their column dividers left or right.

You cannot edit all the columns on this display. For instance, you cannot change the Goal ID or the parent function.
Pasting Data from an Outside Application

Using the standard Windows shortcut keys (Ctrl+C and Ctrl+V), you can copy and paste data into this worksheet. This is handy if you have entered the data in an application such as Excel.

To paste data from outside your application:

1. Be sure that the columns in your source worksheet are in the same order and each column is in the same format (for example, 00:00:00.00 for time values) as IMPRINT Pro expects. This will require that you format the entire sheet to a text format so that values in the format 00:30:00.00 are not translated as 30:00.00.

2. Go to your application and select the data that you want to paste into IMPRINT Pro.

3. Copy the data to the Windows clipboard using Ctrl+C. Alternatively, you may right-mouse click and select Copy from the shortcut menu.

4. Open the Review worksheet.

5. Select the area into which you want to paste the data.

6. Press Ctrl+V. Alternatively, you may right-mouse click and select Paste from the shortcut menu.

   Be sure to double-check that the data are in the correct cells.
**Review Functions**

The purpose of the Review Functions worksheet is to enable you to view all the function data in a tabular format. These data are sorted in order of increasing function identification numbers. The worksheet scrolls left and right so that you can view all the columns. In addition, you can change the widths of individual columns by dragging their column dividers left or right.

You cannot edit all the columns on this display. However, you can change the function time standard and the function criterion data element values.

<table>
<thead>
<tr>
<th>Function ID</th>
<th>Name</th>
<th>Time Req</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Move During March</td>
<td>00:02:51.00</td>
<td>85.00</td>
</tr>
<tr>
<td>2</td>
<td>Crew Maintenance Required</td>
<td>00:00:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>3</td>
<td>Crew Maintenance Not Required</td>
<td>00:00:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>4</td>
<td>Do Not Move Again</td>
<td>00:00:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>5</td>
<td>Move Again</td>
<td>00:00:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>6</td>
<td>Perform After-Firing Checks</td>
<td>01:45:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>7</td>
<td>Perform Post-Operation Checks</td>
<td>00:55:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>8</td>
<td>Power Down and Secure Stations</td>
<td>00:02:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>9</td>
<td>Replace Track Block</td>
<td>00:55:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>10</td>
<td>Clean and Service Man Gun</td>
<td>01:55:00.00</td>
<td>85.00</td>
</tr>
<tr>
<td>11</td>
<td>Perform External Communication</td>
<td>00:01:30.00</td>
<td>85.00</td>
</tr>
<tr>
<td>12</td>
<td>Perform Crew Communication</td>
<td>00:00:30.00</td>
<td>85.00</td>
</tr>
<tr>
<td>13</td>
<td>Adjust Internal Environment</td>
<td>00:00:03.00</td>
<td>85.00</td>
</tr>
</tbody>
</table>

**Pasting Data from an Outside Application**

Using the standard Windows shortcut keys (Ctrl+C and Ctrl+V), you can copy and paste data into this worksheet. This is handy if you have entered the data in an application such as Excel.

**To paste data from outside your application:**

1. Be sure that the columns in your source worksheet are in the same order and each column is in the same format (for example, 00:00:00.00 for time values) as IMPRINT Pro expects. This will require that you format the entire sheet to a text format so that values in the format 00:30:00.00 are not translated as 30:00.00.
2. Go to your application and select the data that you want to paste into IMPRINT Pro.

3. Copy the data to the Windows clipboard, using Ctrl+C. Alternatively, you may right-mouse click and select Copy from the shortcut menu.

4. Open the Review worksheet.

5. Select the area into which you want to paste the data.

6. Press Ctrl+V. Alternatively, you may right-mouse click and select Paste from the shortcut menu.

   Be sure to double-check that the data are in the correct cells.

**Review Tasks**

At the top of the Review Tasks window you will see the items Task Info, Task Demands, and Warfighter Assignments. Select the desired information by clicking the option button adjacent to the item.

*Task Information*

The purpose of the Task Info worksheet is to enable you to view all the task data in a tabular format. These data are sorted in order of increasing function and task identification numbers. The worksheet scrolls left and right so that you can view all the columns. In addition, you can change the widths of individual columns by dragging their column dividers left or right.
Chapter 5: Mission Analysis

You cannot edit all the columns on this display. For instance, you cannot change the Task ID, the parent function, or the task name. However, you can change most of the task performance data.

**Pasting Data from an Outside Application:**

1. Be sure that the columns in your source worksheet are in the same order and each column is in the same format (for example, 00:00:00.00 for time values) as IMPRINT Pro expects. This will require that you format the entire sheet to a text format so that values in the format 00:30:00.00 are not translated as 30:00.00.

2. Go to your application and select the data that you want to paste into IMPRINT Pro.

3. Copy the data to the Windows clipboard, using Ctrl+C. Alternatively, you may right-mouse click and select Copy from the shortcut menu.

4. Open the Review worksheet.

5. Select the area into which you want to paste the data.
6. Press **Ctrl+V**. Alternatively, you may right-mouse click and select **Paste** from the shortcut menu.

Be sure to double-check that the data are in the correct cells.

**Task Demands**

For each RI Channel and Task combination in the mission you will enter task demand values. These values will be used to compute the first order workload components during model execution. The values should indicate the relative demand on each channel when performing a task.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Task</td>
<td>START</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_0</td>
<td>Move to Start Point</td>
<td>START</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_1</td>
<td>Move to Start Point</td>
<td>Sheet bank</td>
<td>0.00</td>
<td>1.20</td>
<td>2.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_2</td>
<td>Move to Start Point</td>
<td>Monitor instruments</td>
<td>1.00</td>
<td>5.20</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_3</td>
<td>Move to Start Point</td>
<td>Monitor terrain</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_4</td>
<td>Move to Start Point</td>
<td>Conduct surveillance (Driver)</td>
<td>0.00</td>
<td>4.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_5</td>
<td>Move to Start Point</td>
<td>Conduct Surveillance (Observer)</td>
<td>0.00</td>
<td>4.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_6</td>
<td>Move to Start Point</td>
<td>Command terrain</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_7</td>
<td>Move to Start Point</td>
<td>and loop</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>1_800</td>
<td>Move to Start Point</td>
<td>END</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_0</td>
<td>Perform communication</td>
<td>START</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_1</td>
<td>Perform communication</td>
<td>Receive Comm (Driver)</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_2</td>
<td>Perform communication</td>
<td>Receive Comm (Observer)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_3</td>
<td>Perform communication</td>
<td>Send Comm (Driver)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_4</td>
<td>Perform communication</td>
<td>Send Comm (Observer)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_5</td>
<td>Perform communication</td>
<td>and command passenger</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2_800</td>
<td>Perform communication</td>
<td>END</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3_0</td>
<td>Move to check point</td>
<td>START</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3_1</td>
<td>Move to check point</td>
<td>Sheet bank</td>
<td>0.00</td>
<td>1.20</td>
<td>2.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3_2</td>
<td>Move to check point</td>
<td>Monitor instruments</td>
<td>1.00</td>
<td>5.20</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3_3</td>
<td>Move to check point</td>
<td>Monitor terrain</td>
<td>0.00</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>3_4</td>
<td>Move to check point</td>
<td>Conduct surveillance (Driver)</td>
<td>0.00</td>
<td>4.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

The window displays a worksheet with tasks and their respective parent functions displayed in the second and third columns from the left, and the resource-interface channels displayed across the top. The tasks are grouped by function, and the channels grouped by resource. The worksheet contains a cell for each demand value that would be required for any given RI channel and task pair. Any demand values previously entered display automatically. The default demand value is 0.00. The worksheet scrolls left and right and up and down if necessary.

**Automatic Task Demands Value Dialog Box**

If the channel involves one of the seven default resources (Auditory, Cognitive, Fine Motor, Gross Motor, Speech, Tactile and Visual) then you can enter a demand value automatically.
To enter a value:

1. Click in the cell of the Task Demands worksheet that corresponds to the desired task and channel.

2. Click the Auto button. This button appears as “…” on the right-hand side of the selected cell.

The Automatic Demands Value dialog box displays.

3. Click the desired demand value from the list.

4. Click OK.

IMPRINT Pro returns to the Task Demands worksheet. The selected Demand Value appears in the selected cell.

5. To cancel out of the Automatic Demand Value dialog and return to the Review Tasks tab, do one of the following:

• Click the Cancel button.
• Click the \( x \) in the upper right hand corner of the Automatic Task Demand Values dialog box.

No new Demand Value appears in the Task Demands dialog box.

\[ \text{\textbf{Note:}} \]

If you defined resources in addition to the default resources, you will not have the automatic entry option. To enter a demand value manually, click once in the demand field and use the numeric, backspace, and delete keys to manually enter a value.

\[ \text{\textbf{Demand Values for the Auditory Channel}} \]

If the channel involves the Auditory resource, IMPRINT Pro can suggest several different task demand values related to the auditory channel. The demand value chosen should be based on the nature of the auditory involvement required by the operator to perform the task at hand.

\[ \text{\textbf{To select the desired task demand value:}} \]

1. Click the option that best describes the auditory involvement for that task.

2. Click \textbf{OK}.

IMPRINT Pro displays the demand value in the cell in the Task Demands worksheet.
3. To close the window without specifying a value, click **Cancel** or click the ❌ in the upper right hand corner.

**Demand Values for the Cognitive Channel**

If the channel involves the Cognitive resource, IMPRINT Pro can suggest several different task demand values related to the cognitive channel from which to choose. The demand value chosen should be based on the nature of the cognitive involvement required by the operator to perform the task at hand.

**To select the desired cognitive value:**

1. Click the option that best describes the cognitive involvement for that task.

2. Click **OK**.

   IMPRINT Pro will display the selected demand value in the cell in the Task Demands worksheet.

3. To close the window without specifying a value, click **Cancel** or click the ❌ in the upper right hand corner.
Demand Values for the Fine Motor Channel

If the channel involves the Fine Motor resource, IMPRINT Pro can suggest several different task demand values related to the fine motor channel from which to choose. The demand value chosen should be based on the nature of the motor involvement required by the operator to perform the task at hand.

To select a desired fine motor value:

1. Click the option that best describes the motor involvement for that task.

2. Click OK.

IMPRINT Pro displays the selected demand value in the cell in the Task Demands worksheet.

3. To close the window without specifying a value, click Cancel or click the X in the upper right hand corner.

Demand Values for the Gross Motor Channel

If the channel involves the Gross Motor resource, IMPRINT Pro can suggest several different task demand values related to the motor channel from which to choose. The demand value chosen should be based on the nature of the gross motor involvement required by the operator to perform the task at hand.
To select a desired gross motor value:

1. Click the option that best describes the gross motor involvement for that task.

2. Click **OK**.

   IMPRINT Pro displays the selected demand value in the cell in the Task Demands worksheet.

3. To close the window without specifying a value, click **Cancel** or click the **X** in the upper right hand corner.

**Demand Values for the Speech Channel**

If the channel involves the Speech resource, IMPRINT Pro can suggest several different task demand values related to the speech channel from which to choose. The demand value chosen should be based on the nature of the speech involvement required by the operator to perform the task at hand.

There are two options for the speech parameter: whether the operator must say one or two words or else an entire sentence. Assign a demand value for this parameter as follows:
To select a desired speech value:

1. Click the option that best describes the number of words the operator must say.

2. Click OK.

   IMPRINT Pro displays the selected demand value in the cell in the Task Demands worksheet.

3. To close the window without specifying a value, click Cancel or click the \( \times \) in the upper right hand corner.

Demand Values for the Tactile Channel

If the channel involves the Tactile resource, IMPRINT Pro can suggest several different task demand values related to the tactile channel from which to choose. The demand value chosen should be based on the nature of the motor involvement required by the operator to perform the task at hand.

To select a desired tactile value:

1. Click the option that best describes the motor involvement for that task.
2. Click **OK**.

IMPRINT Pro displays the selected demand value in the cell in the Task Demands worksheet.

3. To close the window without specifying a value, click **Cancel** or click the **X** in the upper right hand corner.

**Demand Values for the Visual Channel**

If the channel involves the Visual resource, IMPRINT Pro can suggest several different task demand values related to the visual channel. The demand value chosen should be based on the nature of the visual involvement required by the operator to perform the task at hand.

**To select the desired visual value:**

1. Click the drop-down arrow on the Night Vision Goggles box to display the visual values of tasks that will be performed with or without night vision goggles.

2. Click the option that best describes the visual involvement for the task.
3. Click **OK**.

IMPRINT Pro displays the selected demand value in the cell in the worksheet.

4. To close the window without specifying a value, click **Cancel** or click the **X** in the upper right hand corner.

**Note:**
The Visual channel initially displays automatic demand values for the case where the operator does not use night vision goggles. To see a list of values corresponding to workload incurred by an operator wearing night vision goggles, click the drop-down arrow next to the **Night Vision Goggles** field, and then select the **With Night Vision Goggles** option.

**Warfighters Assignments**

The Warfighter Assignments worksheet displays all tasks in the network and all Warfighters which are assigned to them. The first three columns in the worksheet display the Task ID, parent functions and names of the tasks in the network. Each subsequent column represents an individual Warfighters in the mission. At the intersection of any given task row and a Warfighter column is a combo box where the Warfighter assignment for that task is designated. Available assignments are **Primary**, **Contingency** and **no assignment**.
A Warfighter or automation device must be assigned to each task in the mission. Each task can be assigned one primary operator. Each primary operator should be qualified and able to perform the task.

It is also possible to assign up to six contingency Warfighters or devices. A contingency Warfighter will perform the task in the event that the identified primary Warfighter experiences workload overload. Tasks can be reallocated during the simulation only to the designated contingency operator. The workload management strategies, discussed in Chapter 4: “Warfighter Data”, describe how this works.

Operators that have primary responsibility cannot also be assigned contingency responsibility.

RI Pairs

RI Pairs are the resources-interfaces channels used by the operators to perform tasks in a mission. In the Analysis Tree below the RI Pairs node, IMPRINT Pro automatically displays five default resources:

- Auditory
- Cognitive
- Fine Motor
You can add and delete resources from the list. However, if you define additional resources, you must assign their task demand and conflict values manually.

You also need to develop the interface list for your mission. Interfaces are controls and displays that the operator utilizes to perform the tasks in the mission. In the Analysis Tree below the RI Pairs node, IMPRINT Pro automatically displays a single interface:

- Crewstation

You can add and delete interfaces from the list as desired.

**Displaying Resources and Interfaces**

*To display Resources and Interfaces;*

1. Click the + adjacent to RI Pairs node in the Analysis Tree.

   The Resources and Interfaces nodes display below the RI Pairs node in the Analysis Tree:

2. Click the + adjacent to Resources node to see a list of Resources; click the + adjacent to Interfaces node to see a list of Interfaces.

**Adding RI Resources**

Seven default workload resources are provided within IMPRINT Pro. You can add more resources to the list if you desire. Each resource must have a unique name.

*To add a resource:*

1. Right-click **Resources** in the Analysis Tree.
2. Select **Add Resource** from the menu that displays.

The new Resource is added to the list below the Resource node in the Analysis Tree.

✓ **Note:**
IMPRINT Pro will name your new resource Resource. If you continue to add resources, each following resource will be named ResourceX where X is the next integer. You can edit the name of a new resource in the Name field in the Resource Properties dialog box. Default resources cannot be edited.

---

**Adding RI Interfaces**

*To add an Interface:*

1. Right-click the **Interfaces** node in the Analysis Tree.

2. Select **Add Interface** from the menu that displays.

   The new interface is added to the list below the Interface node in the Analysis Tree.

✓ **Note:**
IMPRINT Pro will name your new interface Interface. If you continue to add interfaces, each following interface will be named InterfaceX where X is the next integer. You can edit the name of the interface in the Name field in the Interface Properties dialog box.

---

**Defining Resource-Interface Channels**

Resource-Interface channels, or RI Pairs, are defined by pairing up one resource with one interface, otherwise known as a "channel". For example, pairing up a Fine Motor resource with a Gunner Station interface would result in the Fine Motor/Gunner Station channel.

It is also possible that two channels may conflict with each other in a workload situation, in which case it is possible to assign **Channel Conflict Values**.

Channels and Conflicts are defined at the RI Pairs level of your Analysis. Demands on each channel, however, must be specified for each task individually at the task level.
**To display Resource-Interface Channels and Conflicts:**

Double-click the RI Pairs node in the Analysis Tree.

The RI Pairs dialog box displays. This dialog box includes two tabs: Channels and Conflicts. The Channels tab is selected by default.

The Channels tab comprises a matrix with interfaces down the first column and the resources across the top row. Each cell located at the junction of a resource and an interface in the matrix contains a single check box. When the box is checked, IMPRINT Pro combines that particular resource and interface to form a new channel. This channel then appears in the Workload Demand tab of the Task Information window for any task you select and is available for assigning workload to that task. Any previous resource-interface designations are indicated by checks in the boxes. The worksheet scrolls left, right, up and down to view Resource-Interface channels as desired.

**Creating Resource and Interface Pairs**

**To mark or unmark a resource-interface channel:**

Click the check box inside the cell corresponding to the interface and the resource names.

IMPRINT Pro changes the checked cell to an unchecked cell and vice versa. You can assign each interface to up to five resources by checking up to five cells in the worksheet.

For every interface that Warfighters utilize in performing either primary or contingency tasks, you should assign at least one resource.

**Define Resource-Interface Conflicts**

Click the conflict tab to access a matrix of conflict values among your resource-interface channels.
As tasks are performed by an operator, workload demands are made on the operator’s limited resources across the various workload channels. Whenever two or more tasks are performed simultaneously by the same operator, these tasks compete (interfere) for resources across these channels. This competition, known as conflict, contributes to the overall workload an operator will experience and the likelihood that performance will deteriorate below its single task level (Wickens, 2002, 2005). Two tasks will compete (interfere) with each other more to the extent that they share a common resource. This amount of conflict between any two resource-channel pairs is set by the user in the RI Pairs window under the conflicts tab.

There are three possible classes of conflict between tasks that are performed concurrently:

- **Class 1**: Identical tasks (e.g., two keyboarding tasks)

- **Class 2**: two different tasks but with identical resource conflict (e.g. a keyboarding task and a writing task, both with the same fine motor demands.)

- **Class 3**: two different tasks with different resource channels. (e.g., visual search V and problem solving C). Here resource conflict will exist, although it may be diminished from cases 1 and 2.

In all three cases, the amount of resource conflict is embedded within the conflict matrix; you will typically choose default values which are based upon multiple resource theory or enter values manually.
Importantly, there is one other factor that may, in some cases, modify the interference conflict in the case of two tasks demanding the same resource, namely the way in which various types of tasks may be represented by the exact same channel pair in your model. For example, two fine motor typing tasks using the same hand will interfere more than the same typing task using different hands, yet both tasks might be represented by the same fine motor-keyboard channel. Two visual tasks separated by 20 degrees of visual angle will interfere more than two separated by 2 degrees, yet they might also be represented by the same visual-crewstation channel. Channel conflict values are meant to represent the average conflict between channels globally for all tasks in your network and do not differentiate between any two tasks that could be represented by the same channel. To accommodate for this issue in the case of the visual task example above, you may choose to use your current visual-interface channel for the workload performed in the 20 degree case and then add a new visual-interface (2) channel for which you can set unique demand values for the 2 degree case. You may then set the desired conflict value between these similar but unique channels in the conflicts matrix of the RI Pairs window. You would probably use the default conflict value for 2 degrees, but raise this to a much higher value at 20 degrees since it is nearly impossible to process inputs for two visual sources separated by 20 degrees.

Conflict values range from 0.00 to 1.00. A conflict value of 0.00 means that the two channels do not interfere with each other at all. A conflict value of 1.00 means that the two channels are in total conflict. This conflict automatically causes a workload overload condition, since the two channels cannot be utilized at the same time.

When you run a model for which conflicts are defined, you can review a list of all occurrences of channel conflict in the model run through the Channel Conflict Report. In the event an operator is given two simultaneously conflicting tasks to perform but instead hands off one of those tasks to a contingency operator because of his/her workload strategy, the original operator's workload is now reduced to that of a single task. In this case, the operator is no longer in a conflict situation (which would require a minimum of two simultaneous tasks) thus the report shows no record of conflict for that instance.

IMPRINT Pro has two modes available to you for assigning the conflict values:

1. **Automatic mode.** Assign conflict values between resources based on expert opinion and research. First, begin by selecting a channel (clicking its row in the matrix) and then clicking the Auto button; IMPRINT Pro, in some cases, may prompt you for sub-parameters related to this channel, for example after clicking the Auto button for an
Auditory-Crewstation channel you might be prompted to specify whether the channel carries verbal information or tonal information by checking the corresponding check box. After selecting additional parameters, where applicable, IMPRINT Pro then populates the cells in the conflict matrix with the corresponding default conflict values. Automatic mode is only available for channels that utilize one of the seven default resources (auditory, cognitive, fine motor, gross motor, speech, tactile and visual).

2. **Manual mode.** Manually enter your own conflict value for the channel. Channels that utilize other resources than the five default resources (auditory, cognitive, fine motor, gross motor, speech, tactile and visual) must have conflict values manually entered.

The Conflicts window displays a worksheet with the resource-interface channels displayed both down the left column and across the top. The channels are grouped by resource. Any previously defined conflict values are displayed in the worksheet cells. The default conflict value is 0.00.

**Entering Conflict Value**

To enter a conflict value in automatic mode:

1. Click the cell under the **RI Pairs** column corresponding to the resource-interface pair requiring conflict values.

   All cells in the selected row highlight in blue.

2. Click the **Auto** button at the top of the dialog box.

   For some resources a new dialog box opens, depending on the resource.
3. If applicable, select the parameter appropriate to your channel’s resource, and then click OK.

The conflict values recommended by IMPRINT Pro for the parameter you selected automatically display in the cells in the worksheet. See additional details in “Automatic Data Entry” on page 203.

✓ Note:
For resources which do not have additional parameters, the Auto button automatically fills in the cells with default conflict values.

To manually enter a conflict value:

1. Click the cell corresponding to the resource-interface pairs requiring conflict values.

2. Use the keyboard to enter a conflict value from 0.00 to 1.00.
Automatic Data Entry

When the **Auto** button is clicked, for some channels an Automatic Data dialog box displays. The options appearing in these Automatic Data boxes are characteristics of the selected channel that determine how much conflict occurs between and within the channels, based on human workload research. Once the automatic data dialog box is open, you can click the option button adjacent to option that best fits the resource-interface channel you are defining, and then click **OK**.

**Automatic Data for Auditory**

Options available on the Automatic Data for Auditory dialog box:

- **Channel carries Verbal information.** This channel involves speech.
- **Channel carries Tonal information.** This channel involves sound.

Note:
You can also choose to not select either of these parameters.

**Automatic Data for Cognitive**

The option available on the Automatic Data for Cognitive dialog box is:

- **Channel is spatial.** This channel involves peripheral vision.
You may check the Channel is Spatial option or leave it unchecked.

**Automatic Data for Fine Motor**

The option available on the Automatic Data for Motor dialog box is:

- **Channel requires verbal information**

The requirement of verbal information for a fine motor task refers to the requirement of receiving verbal instruction while performing the fine motor task. For example, manipulating the control column of an aircraft while receiving verbal instruction over the radio is a fine motor task which requires verbal information.

You may check the **Channel requires verbal information** option or leave it unchecked.

**Automatic Data for Visual**

Options available on the Automatic Data for Visual dialog box include:

- **Channel has verbal information.** This channel involves speech.

- **Channel requires foveal fixation.** This channel requires focus.
You can check one, both or neither of the options for the Visual channel.

Note:
Channels involving the default resources Gross Motor, Speech and Tactile do not have additional parameters. For these resources, clicking on the Auto button automatically populates the matrix with their default conflict values.

Macros

Custom or user-defined macros are useful when you need to perform the same calculation or procedure several times in mission. Instead of retyping the necessary expressions every place you need them, you can first create the macro once for a mission. Then, wherever you need the calculation or procedure to be performed in the mission, you simply type the name of the macro followed by parentheses ( ).

Because you can assign more than one expression to a macro, you can use macros to perform procedures. For example, suppose you want to assign values to several variables based on the state of the simulation at various points in the mission. You could define a macro called SystemChange( ). Whenever the macro is executed, IMPRINT Pro executes all of the expressions in the macro and returns the value of the last expression.

Displaying Defined Macros

If a macro has already been defined for your mission, you can display the macro below the Macro node in the Analysis Tree and the main window. If no macros have been defined for your mission, see “Adding Macros” on page 206.

To display defined macros:

Do one of the following:
• In the Analysis Tree, click the + adjacent to Macros item to expand it. A list of defined macros displays in the Analysis Tree.
• In the Analysis Tree, double-click the Macros node to display the list of macros in the main window.

Adding Macros

To add a macro:

In the Analysis Tree, right-click the Macros node, and then select Add Macro from the menu that displays.

The new macro is added below the Macro node in the Analysis Tree.

Note:
IMPRINT Pro names the new macro Macro. If you continue to add Macros, each following macro will be named Macro1 and is numbered, increasing by one for each addition. You can edit the name of the macro in the Macro information dialog box or the “Displaying Macro Information and Parameters” on page 206 window name box.

Displaying Macro Information and Parameters

The Macro Description dialog box displays the name of the macro at the top. The dialog box also includes macro properties on the two tabbed dialogs: Macro Info and Parameters.

To display a macro dialog box:

1. In the Analysis Tree, click the + adjacent to Macros node to expand it.
2. Double-click the macro name (for example, Macro1).

The Macro dialog box displays in the main window.
Chapter 5: Mission Analysis

Renaming Macros

*To rename a macro:*

Do one of the following:

- Set the cursor in the Macro Name field in the Macro Description dialog box, and then type in a new name.
- Click the Macro in the Analysis Tree to select it, and in the Properties Window edit the contents of the **Name** field as desired.

Macro names must begin with a letter or underscore and can be followed by zero or more letters, numbers, and underscore characters. Macro names are case-sensitive. The C# language reserves 76 words for its own use. Do not use any of these keywords as macro names. For a list of reserved names, see “Adding Variables” on page 213.

The new macro name is added to the list of macros in the Analysis Tree and the main window.

**Macro Info Tab**

The Macro Info tab is the first tab in the Macro Description dialog box.
To open the Macro Info tab:

Click the Macro Info tab in the Macro Description dialog box.

Following is a detailed description of the properties on the Macro Info tab.

- **Name.** This field contains the macro name.

- **Return Type.** This field contains the variable type for the return value. Selections include integer, floating, string, boolean, entity, arbitrary, object, and void. Void types do not return a value. For descriptions, see Variable Types in “Variable Properties” on page 214.

- **Is Array.** Checking this box indicates the return value is an array. An array is an ordered set of variable values that are indexed to a single variable name. An array can be a one-dimensional list, a two-dimensional table of rows and columns, or a multi-dimensional array.

- **Dimensions.** Contains the indexes for the return value when it is an array. Type the upper index for each dimension, separated by a comma. By default the lower index for each dimension is zero. For example, if you enter 30, 40, 50, 60, you are defining a four-dimensional array with indices of 0-29, 0-39, 0-49, and 0-59. There is no limit on the number of dimensions you can use.

- **Code.** Contains the expressions defining the macro. To return a value from the macro, you must include a return statement in the macro definition. The variable type for the return value is specified in the Return Information tab. For details on return statements, see Return Statements in *IMPRINT Pro Syntax Reference Manual*, Vol.3 of *IMPRINT Pro User Guide*.

**Macro Parameters Tab**

The Parameters tab is the second tab in the Macro Description dialog box. It contains optional variables that a macro can assign to a local variable inside the macro.

To open the Parameters tab:

Click the Parameters tab.

The Parameters dialog box displays.
To add a parameter:

1. Click the **Add** button on the Parameters dialog box.
2. Enter the Name, Type, Array information, and Array dimensions.

To delete a parameter:

1. Select the parameter.
2. Click the **Delete** button on the Parameters dialog box.

For details on the variable properties, see “Variable Properties” on page 214.

Editing Macros

To edit a macro:

1. In the Analysis Tree, click the + adjacent to Macros node to expand it, then double-click the macro you want to edit.

   The Macro Description dialog box displays in the main window and the associated Properties window for the macro displays.

2. Make changes to the Macro properties as desired.

   For details on macro properties, see “Displaying Macro Information and Parameters” on page 206.
Copying Macros

You can copy macros and then paste them into another mission or analysis.

To copy a macro:

Do one of the following:

• Right-click the macro in the Analysis Tree you want to copy, and then select Copy from the menu that displays.
• Select the macro you want to copy, and then select Copy on the Edit menu.
• Select the macro you want to copy, and then click the Copy button on the tool bar.

Cutting Macros

You can cut a macro to remove it from its location to another location in the analysis.

To cut a macro:

Do one of the following:

• Right-click the macro you want to cut, and then select Cut Macro from the menu that displays.
• Select the macro you want to cut, and then click the Cut button on the tool bar.
• Select the macro you want to cut, and select Cut on the Edit menu.

The cut macro highlights in red and remains in its location on the Analysis Tree until you paste the macro to another Macro node. Once you perform the Paste command, the macro will be removed from its current location and appear in its new location.

Pasting Macros

Macros can be copied or cut, then pasted to a Macro node in other missions.

To paste a macro:

1. Copy or cut the macro.
2. Do one of the following:
   • Right-click in the macro node in the Analysis Tree to which you want to paste the macro, and then select **Paste Macro** from the menu that displays.
   • Select the Macro node to which you want to paste the macro, and select **Paste** on the **Edit** menu.
   • Select the Macro node to which you want to paste the macro, and click the **Paste** button on the tool bar.

   The macro appears below the destination Macro node. If you used the Cut command, the cut macro will be removed from its previous position.

**Deleting Macros**

**To delete a macro:**

1. Select the macro in the Analysis Tree.

2. Do one of the following:
   • Right-click the macro, and then select **Delete Macro** from the menu that displays.
   • Press the **Delete** key on the keyboard.

   The macro is deleted.

**Batch Initialization Macros**

Because IMPRINT Pro macros are called prior to model execution, it is possible to create a macro which alters the values of your model’s variables before each run in the simulation. This method is known as batch initialization.

**To Enable Batch Initialization:**

1. Right-mouse click the **Macros** node in the tree, and then select the option **Add Macro** from the shortcut menu.

2. Double-click the macro to display its properties. In the **Macro Name** field, rename the macro “BatchInitialization”.

3. Set the **Return Type** of this macro to **Void**.
4. In the **Macro Code** box, set any variable to the desired value for a model run. Remember: the value `Model.RunNumber` is available if you wish to set the value of a variable based on the current run number. Do not include any parameters in this macro.

5. Set the **Number of Runs** on the **Execution Settings** page.

6. Run the model.

If present, this macro will be called before the model begins execution.

**Variables**

You may add variables to an IMPRINT Pro mission. All variables associated with the mission display in the Analysis Tree below the **Variables** node and in the main window when you double-click the node. You can display variable descriptions, and add, edit, and delete variables. You can also create watches to observe the changes in variables during mission execution. For details on watches, see “Variable Watches Tab” on page 291.

IMPRINT Pro recognizes global and local variables. Only global variables need to be defined. For details on the differences between the two variable types, see Variable Scoping in *IMPRINT PRO Syntax Reference Manual*, Vol.3 of *IMPRINT Pro User Guide*.

For a list of system variables, see “System Variables” on page 218.

**Displaying Defined Variables**

**To display defined variables:**

Do one of the following:
- In the Analysis Tree, click the + adjacent to Variables node to expand it.
  
  A list of defined variables displays in the Analysis Tree.

- Double-click the Variable node.

  A list of Variables display in the main window.
### Adding Variables

**To add a variable:**

1. In the Analysis Tree, right-click the **Variables** node.

2. Click **Add Variable** from the menu that displays.

   The new variable is added below the Variable node in the Analysis Tree.

---

**Note:**

IMPRINT Pro names the new variable Variable. If you continue to add variables, each following variable will be named Variable1 and is numbered, increasing by one for each addition. You can edit the name of the variable in the Variable Parameter dialog box or in the Name field in the Variable Properties dialog box.

Variable names must begin with a letter or underscore and can be followed by zero or more letters, numbers, and underscore characters (examples: *abc, _abc, _aa12*). Variable names are case-sensitive.

The C# language reserves 76 words for its own use. Do not use these keywords as variable names. The following key words should not be used when defining your own variables:

- abstract, as, base, bool, break, byte, case, catch, char, checked, class, const, continue, decimal, default, delegate, do, double, else, enum, event, explicit, extern, false, finally, fixed, float, for, foreach, goto, if, implicit, in, int, interface, internal, is, lock, long, namespace, new, null, object, operator, out, override, params, private, protected, public, readonly, ref, return, sbyte, sealed, short, sizeof, stackalloc, static, string, struct, switch, this, throw, true, try, typeof, unit, ulong, unchecked, unsafe, ushort, using, virtual, void, and while.
Displaying Variable Descriptions

To display a variable description:

1. In the Analysis Tree, click the + adjacent to Variables node to expand it.

2. Double-click the variable name.

The Variable Description dialog box displays in the main window, displaying properties of the variable. If using Custom Layout 1 view, these same properties appear in the Properties window.

Variable Properties

The properties used to define a variable include the variable type, the initial value, whether or not the variable is an array, indexes for an array, and any variable notes.

Following are detailed descriptions of the variable properties.

- **Variable Name.** This field contains the name of the variable.

- **Variable Type.** This field contains the variable type. Selections include boolean, entity, floating point, integer, object, string, void, and hashtable.

  *Boolean variables* are variables that are true or false only. Boolean variables are often used as flags to indicate whether a condition is true or false.

  *Entity variables* point to a specific entity in the mission.
**Floating Point variables**, also called doubles or real numbers, are numbers that are not whole numbers. Floating point numbers can range between 5.0 x 10^{-324} to 1.7 x 10^{308}; precision in IMPRINT Pro is fifteen significant digits. IMPRINT Pro displays floating point variables with four digits to the right of the decimal point. Variables that store clock values or measurements of other continuous quantities should be defined as floating point, because they can contain noninteger values.

**Hashtable variables** map keys to values.

**Integer variables** are any whole number between approximately -2 billion and +2 billion (+2,147,483,648 and -2,147,483,647 inclusive). Variables that count discrete objects should be defined as integers.

**Object variables** are variables that accept all types of values, from string to integer to floating point. These types of variables are mainly used with the Suspend and Resume functions that require a value of both a string and an integer. For example, if you wanted to Suspend task 3 with tag 3, then the Suspend function would require an array that holds both a string (for the task ID) and an integer (for the task tag). An object array would allow for this.

**String variables** are variables that consist of alphanumeric characters. You can use string variables in any expression. When you create a string variable, it does not need to be enclosed in quotes in the Initial Value text box. However, you must enclose the string variable in quotes if it is used in any other place, such as `string1 = IMPRINT Pro is great`.

**Void** types do not return a variable.

- **Is Array.** This check box indicates whether or not the variable is an array. An array is an ordered set of values or elements identified by a single name. Each array element is referred to by the array’s name and the element’s position in the array. The position is indicated by a set of index values enclosed in square brackets and separated by commas; index values can be constants or expressions. Arrays can contain integers or real numbers, but not both.

Following is an example of an array named Array1. The dimensions of the array are 4 x 2. To reference the cell with the value 98, you would use `Array1[2,1]`. 

---

215
Y Initial Value. Contains the initial value you assign for the variable. If the variable is an array, the initial value applies to all elements. You can also supply an initial value for a non-array variable or an element of an array by defining a external event that executes at time zero. Defining an initial value this way is equivalent to defining it in the Initial Value field. If you set the values in the Event Queue, you can make the value of the variables change at different times (for example, staffing shift changes).

Y Cultural. This field indicates whether or not the variable will be available to the user in Cultural Templates.

Editing Variables

To edit a variable:

1. In the Analysis Tree, click the + adjacent to Variables node to expand it, and then double-click the variable you want to edit.

   The Variable Description dialog box appears in the main window, displaying properties of this variable. The Properties Window also updates to display this same information.

2. Make changes to the variable's properties as desired.

   For details on variable properties, see “Variable Properties” on page 214.

Copying Variables

You can copy variables and then paste them into another mission.
**To copy a variable:**

Right-click the variable in the Analysis Tree you want to copy, and then select **Copy** from the menu that displays.

The variable and all its associated data will be copied to Windows clipboard.

**Cutting Variables**

You can cut a variable to move it to another analysis.

**To cut a variable:**

1. Right-click the variable you want to cut.
2. Select **Cut** from the menu that displays.

The variable highlights in red and remains in its same location in the Analysis Tree until you paste it to a new location. Once you perform a Paste command, the variable will be removed from its old location.

**Pasting Variables**

Variables can be copied or cut, then pasted into other missions.

**To paste a variable:**

Copy or cut the variable and do one of the following:

- Right-click in the variable node in the Analysis Tree to which you want to paste to, and select **Paste Variable** from the menu that displays.
- Select the Variable node to which you want to paste the variable, and select **Paste** on the **Edit** menu.
- Select the Variable node to which you want to paste the variable, and click the **Paste** button on the tool bar.

The variable will appear below the destination Variable node. If using the Cut command, the cut variable will be removed from its previous location once it is pasted to the new location.
Deleting Variables

To delete a variable:

1. In the Analysis Tree select the variable you want to delete.

2. Do one of the following:
   - Press the Delete key on the keyboard.
   - Right-click the variable and select Delete Variable from the menu that displays.
   - The variable is deleted.

System Variables

IMPRINT Pro uses the following system variables:

- **Clock.** Clock records elapsed time (in simulation time seconds) since the beginning of mission execution. You can use Clock in any expression in a mission, but use care in changing its value. To record the time at which an event occurred, set another variable equal to Clock as an effect of the event, for example, FinishTime = Clock. You can also use the variable Clock when the time controls what happens, for example:

  ```
  if (Clock >= 1200)
  {
    Operators = CrewSize;
  }
  ```

- **Model.** Model is used to control model actions, such as Model.Start or Model.Pause. These are represented in the Analysis Tree below the Variables node by the single item Model(MAAD.Simulator.Model).

- **Task.** Task includes all property attached to each task in the network model.
Snapshots

Snapshots record the values of selected variables at specified points during mission execution. By default, IMPRINT Pro includes several snapshots that are used in the Operations Results reports. Data automatically collected include: workload levels for each operator, task status information (busy, not busy, suspended, stopped), and task failure information. The Snapshot feature may also be used to define custom data collection where you specify the variable values to collect at runtime. You can define new snapshot files, modify existing snapshot files, and delete existing snapshot files from this window.

Data collection snapshots can be triggered in several ways. You can specify snapshots to occur at specific clock times (one-time or repeating), when a task begins or ends, or when the model run ends. Any snapshots which are set to occur when a task begins are taken at the very end of the Beginning Effect of that task. Any snapshots which are set to occur when a task ends are taken at the very end of the Ending Effect of that task.

For each snapshot, the following information must be supplied:

- A name for the snapshot file in which the data will be stored
- The trigger type (End of Run, Clock, Begin Task, End Task)
- The name of the triggering function and task, if the snapshot has a task trigger
- The start time, stop time, and repeat interval, as applicable, if the snapshot has a clock trigger
- The names of the variables whose values IMPRINT Pro should record

IMPRINT Pro displays snapshot data as a worksheet in the Operational Results reports. The name of this worksheet is the same name you give your snapshot in the Snapshot Information window.
Displaying Defined Snapshots

To display defined snapshots:

In the Analysis Tree, click the + adjacent to Snapshot node to display a list of snapshots below the node.

Adding Snapshots

To add a snapshot:

In the Analysis Tree, right-click the Snapshots node, and select Add Snapshot on the menu that displays.

Note:
IMPRINT Pro names the new snapshot Snapshot. If you continue to add Snapshots, the following snapshot will be named Snapshot1 and each consecutive snapshot is numbered, increasing by one for each addition. You can edit the name of the snapshot in the Snapshot description dialog box or the Snapshot Properties window name box.

Displaying Snapshot Descriptions

To display a snapshot description:

1. In the Analysis Tree, double-click the snapshot name to open the Snapshot Description dialog box.

2. Enter the properties defining the snapshot.

Properties are described in “Snapshot Properties” on page 221.
Chapter 5: Mission Analysis

Snapshot Properties

The Mission Name and Snapshot name display at the top of the Snapshot description dialog box. You can change the name from the default. Snapshot names must begin with a letter or underscore and can be followed by zero or more letters, numbers, and underscore characters. Spaces are not allowed. Snapshot names are case-sensitive.

To name a snapshot:

1. Double-click a snapshot in the Analysis Tree to open up the Snapshot Description dialog box.

2. Click in the Snapshot Name field in the Snapshot Description dialog box.

3. Enter a name to which the data will be stored (maximum of 8 characters).

Below the Mission name and the Snapshot name two tabs display in the Snapshot dialog box:

- Snapshot Info tab
- Snapshot Variables tab
Snapshot Info Tab

The Snapshot Info tab includes Trigger Type, Function, Task, start time for the snapshot, a stop time, and repeat interval, as applicable, if the snapshot has a clock trigger. Following are detailed descriptions of Snapshot properties found on the Snapshot Info tab:

- **Trigger Type.** Contains the condition to trigger the snapshot. Select from the following drop-down list:
  - **Clock.** Triggers the snapshot at a specific time. The system variable Clock is automatically included in every snapshot description that you add, but you can delete it.
  - **Begin Task.** Triggers the snapshot at the beginning of the task.
  - **End Task.** Triggers the snapshot at the end of the task.
  - **End of Run.** Triggers the snapshot at the end of the run.
  - **None.** The snapshot never triggers.

  Based upon the trigger type selected, IMPRINT Pro will enable or disable other properties to be defined.

- **Function.** For task-based triggers, click the drop-down arrow in this field, and then select the parent function of the desired trigger task.

- **Task.** For task-based triggers, click the drop-down arrow in this field, and then select the desired task.

- **Start Time.** For time-based triggers, enter the start time in this field.

- **Stop.** Once this box is checked, the Stop Time box becomes enabled.

- **Stop Time.** Contains the Stop Time if the snapshot has a clock trigger.

- **Is Repeating.** Select this check box for the snapshot to be repeating.

- **Interval.** When you select the **Is Repeating** check box, the Repeat interval field, specified in this field, is enabled.
Snapshot Variables Tab

In order to define snapshots of variables in IMPRINT Pro, your mission must have defined variables below the Variables node in the Analysis Tree.

*To specify the variables for which IMPRINT Pro will store values:*

1. Select the Snapshot Variables tab.

2. Click the **Add** button.

   A defined variable displays in the **Variable Name** column with a drop-down arrow to the right of the box.

3. Click the drop-down arrow to the right of the variable.

   IMPRINT Pro displays the list of available variables that have been defined for the mission and may be added to the snapshot.

4. Choose a different variable from the list by clicking it, or choose to keep the default variable by clicking outside the list.

   The listed variable is added to the snapshot.

5. Repeat Steps 2-4 for each variable whose values you wish to add to your snapshot file.
Editing Snapshots

To edit a snapshot:

1. Double-click the snapshot you want to edit.

   The Snapshots Description dialog box displays in the main window, displaying properties of this snapshot. The Properties Window also updates to display the same information.

2. Make changes to the snapshot properties as desired.

   For details on snapshot properties, see “Snapshot Properties” on page 221.

Deleting Snapshots

To delete a snapshot:

1. In the Analysis Tree, select the snapshot you want to delete.

2. Do one of the following:
   • Right-click the snapshot, and then select Delete Snapshot from the menu that displays.
   • Press the Delete key on the keyboard.

   The snapshot is deleted.

Showing Snapshot Results

You can show the results of the snapshot data you have collected for your mission.

To show results:

1. After executing the mission, in the Analysis Tree right-click the listed snapshot you have defined for data collection (for example, Snapshot1).

2. Select Show Results from the menu that displays.

   A new Snapshot tab appears in the main IMPRINT Pro window, displaying snapshot data for the selected variables. This same data appears in Operations Results reports when the Snapshot report option is selected.
Exporting Snapshot Results Files

You can export result data for snapshot information. A different file is created for each snapshot.

To export the results file:

1. After executing the mission, in the Analysis Tree right-click the snapshot you have defined for data collection.

2. Select Export Results File.

The Export Snapshot result file dialog box displays.

3. In the Save in box, browse and select the destination folder in which snapshot data should be saved.

4. In the File name box, enter a file name.

5. In the Save as type box, select which format which you want to save the snapshot results in:
   • HTML
   • .XML
6. Click **Save**.

   The exported snapshot data exports to the name and location you specified.

**Opening Snapshot Files in Excel**

You can export snapshot data files from IMPRINT Pro and open them in another application, such as Excel, for analysis.

**External Events**

External events provide a way for you to cause certain events to occur at specific times during mission execution. These can be one-time events or they can repeat at regular intervals. External events are often used to change variable values and thereby change the state of the mission. For example, you could have a variable called *Temperature* that would increase at one-hour intervals during the day, and decrease at night. You could then make the time for a specific task such as warming up an engine dependent upon the current temperature.

External events assign values to variables independent of when an entity begins or ends a task, or enters or departs a queue. External events supersede what is happening in the task network.

**Adding External Events**

*To add an external event:*

   In the Analysis Tree, right-click the **External Events** node and select **Add External Event** from the menu that displays.

   A new external event displays below the External Event Node in the Analysis Tree.

**Note:**

IMPRINT Pro names the new external event *ExternEvent*. If you continue to add external events, the next external event will be named *ExternalEvent1*; each following event is numbered, increasing by one for each addition. You can edit the name of the external events in the External Events description dialog box or the External Events Properties window name box.
Displaying External Events

You can display a list of external events associated with the mission in the Analysis Tree below the External Events node and in the main window.

To display a list of external events in the Analysis Tree:

Click the + adjacent to External Event node.

A list of defined external events display below the External Event node.

To display external events in the main window:

In the Analysis Tree, double-click the External Events node.

The External Events dialog box displays a worksheet of any previously defined events in rows with columnar headings. Data includes:

- Name
- Appearance time
- Function Triggered
- Task Triggered
- Description

Displaying External Event Properties

To display external event properties:

1. In the Analysis Tree, click the + beside External Events node to expand the list of external events below the node.

2. Double-click the external event name (for example, ExternalEvent1).

External Event properties display in the main window.
External Event Properties

The External Event dialog box contains an appearance time box, a description for the event, and the Function and Task triggered for the scheduled event.

Following are detailed descriptions of External Event properties.

- **Appearance time.** The appearance time identifies the time that the event occurs during the mission. Click in the appearance time field to enter an appearance time for the external event.

- **Description.** A textual description of the external event.

- **Function Triggered.** The function triggered property identifies the function that will begin when this external event occurs.

- **Task Triggered.** The task triggered property identifies the task that will begin when this event occurs. Before specifying a task to be triggered, you must identify the parent function of that task. To specify the function and task that are triggered, click in the appropriate field, and select the name from the list.

Editing External Events

To edit an external event:

1. In the Analysis Tree, click the + beside **External Events** node to expand the list of external events below the node.

2. Double-click the external event you wish to edit.
3. Click in the box whose value you wish to change, and edit it as necessary.

**Copying External Events**

You can copy external events and then paste them to another mission.

*To copy an external event:*

Right-click the event in the Analysis Tree you wish to copy, and then select **Copy External Event** from the menu that displays.

The external event and all its associated data copies to Windows clipboard.

**Cutting External Events**

You can cut an external event to move it to another mission.

*To cut an external event:*

1. Right-click the event you wish to cut.
2. Select **Cut External Event** from the menu that displays.

   The external event highlights in red and remains in its location in the Analysis Tree until you paste it to a new location. Once you perform a Paste command, the external event will be removed from its old location.

**Pasting External Events**

External events can be copied or cut and then pasted into other missions.

*To paste an external event:*

Right-click in the External Event node in the Analysis Tree to which you want to paste the cut or copied event, and select **Paste External Event** from the menu that displays.

The external event appears below the **External Event** node to which you pasted it. If you used the Cut command, the cut event will be removed from its previous location.
Deleting External Events

To delete an external event:

1. In the Analysis Tree, click the + adjacent to External Events node to expand the list below the node.

2. Select the event you wish to delete.

3. Do one of the following:
   • Right-click the event, and then select Delete External Event from the menu that displays.
   • Press the Delete key on the keyboard.

   The external event is deleted.

Viewing the Execution of External Events

To view the execution of external events:

1. In the View menu, select the Windows command and then select Event Queue from the window that displays.

2. From the Execution menu, select Begin Simulation.

   External events display in the Event Queue window during mission execution.

Charts

The Chart option allows you to display a plot of one mission variable against another. Since the value of your model’s variables is determined at run-time, the points representing these variables’ values are plotted on the chart at run time as the animation progresses.
Adding Charts

To add a chart:

1. Right-click the **Charts** node in the Analysis Tree.

2. Select **New Chart** from the menu which displays.

A new Chart displays below the Charts node in the Analysis Tree.

**Note:**
IMPRINT Pro names the new chart Chart. If you continue to add charts, the first new chart will be named Chart1, and each following chart will be numbered, increasing by one for each addition. You can edit the name of the chart in the Chart Properties dialog box in the main window or the Chart Properties window name field.

Displaying a list of Charts

You can display a list of charts associated with the mission in the Analysis Tree below the Chart node and in the main window.
To display a list of charts in the Analysis Tree:

Click the + adjacent to Charts node.

A list of defined charts displays below the Charts node.

To display a list of charts in the main window:

In the Analysis Tree, double-click the Chart node.

This action will display a list of Charts in the main window.

Displaying a Chart

The Chart Display window appears upon executing the model. The window plots the updated values of your selected variables in chart-form as the simulation progresses. The entire chart is not available until the simulation ends.

To display a chart:

1. From the Utilities menu, enable the Display Charts option.

   The Display Charts option opens the chart display window at model run-time.

2. From the Utilities menu, enable the Display Trace option.

   The Display Trace option enables the chart display to refresh as subsequent points are calculated during the model run. Without the Display Trace option enabled, the chart cannot be viewed while the model runs.

3. Run the model.

   The Chart display window appears, plotting the selected variables as the simulation progresses.
Data appears in both graphical and tabular formats. To view the exact value of a plotted point, position the cursor on the point - a tooltip appears over the point, listing the X and Y values of the point. The table at the bottom highlights the corresponding values.

Chart Properties

When creating a chart for display, the Chart Information Tab and the Chart Properties window can be used to select one or more variables to plot along time or against another variable. These windows also allows you to specify the minimum and maximum display ranges and to select colors and shapes of the plotted points.

To display Chart Properties:

Double-click of the chart listed below the Chart node in the Analysis Tree.

The Chart Information tab displays.
The Properties Window updates to display the same information.

- **Name.** The name of the selected chart.
- **Description.** The description of the selected chart.
- **Chart Type.** The method by which data displays in the chart, for example, data may be presented in the formats of line charts, pie charts and scatter charts.
- **Show Chart.** Click this button to jump to the chart display.
- **Automatic Plotting.** Checking this box enables the chart to plot a data point on the chart for each event in the simulation.
• **Enable X-Axis Range.** Checking this box enables the X-Axis Min and X-Axis Max fields if a smaller display range is desired. Once checked, enter the desired X-Axis Min and X-Axis Max values. If left unchecked, the chart displays the entire time range for the duration of the simulation run and all carbon-dating points provided those points also fall within range of the selected y-axis limits.

• **X-Axis Min.** The starting value of the range of values displayed along the chart’s x-axis.

• **X-Axis Max.** The ending value of the range of values displayed along the chart’s x-axis.

• **Enable Y-Axis Range.** Checking this box enables the Y-Axis Min and Y-Axis Max fields if a smaller display range is desired. Once checked, enter the desired Y-Axis Min and Y-Axis Max values. If left unchecked, the chart displays the entire time range for the duration of the simulation run and all corresponding points provided those points also fall within range of the selected x-axis limits.

• **Y-Axis Min.** The starting value of the range of values displayed along the chart’s y-axis.

• **Y-Axis Max.** The ending value of the range of values displayed along the chart’s y-axis.

**Creating a Chart Series**

The series of points displayed in the chart window occur as a result of plotting one variable against another. Creating this series first requires deciding which two variables in your mission to use. By default, all missions contain the variable Clock which is useful for plotting any variable against time. Next, each of the two variables is assigned either the X or Y axis.

**To create a chart series**

1. In the Chart information window, click the Series List tab.

2. To add a new series, click the **Add...** button.

   A new series description line appears in the list.

3. Under the X column, select the variable to display along the x-axis from the drop-down menu in the cell.
4. Under the Y column, select the variable to display along the y-axis from the drop-down menu in the cell.

5. From the Color column, select a color for the points in the series.

6. From the Shape column, select the shape of the point markers on the chart using the drop-down list provided.
7. Run the model.

The chart display window appears, and the chart draws as the simulation runs.

Chart Tools

The Chart display window comes with a variety of tools that can be used to customize your chart. These tools may be found at the top of the chart display window.
Options include:

- **Personalized Charts.**

- **Copy to Clipboard.** Save the chart display of your data as a bitmap or metafile which may then be pasted into an image editing application. Alternatively you may save all point data to a text file.

- **Print.** Print the chart display.

- **Gallery.** Change the display format of your data.

- **Anti-Aliasing.** Smooth any lines connecting the points in the display.

- **Palette Selector.** Change the palette of available colors for the symbols, lines and background display.

- **3D/2D.** Choose a two-dimensional or three-dimensional display of your data.

- **Axes Settings.** Modify the appearance of the axes tables and markings.

- **Point Labels.** Show or hide data point labels next to your points.

- **Data Grid.** Show or hide the data grid below the chart display. The data grid contains all data in a tabular format.

- **Legend Box.** Show or hide the Legend Box on the display. The Legend Box correlates the chart symbols with the data series.

- **Zoom.** Zoom into any portion of the chart. To enable this feature click the Zoom button, and then select the portion of the chart to Zoom by left clicking and dragging your mouse around the desired area.
**Properties.** Access all properties of your chart display in a convenient Properties dialog box.

**Copying Charts**

*To copy a chart:*

1. Right-click the chart.

2. Select **Copy Chart** from the menu that displays.

   Once you have copied the chart, you can paste to a Chart node in another analysis.

**Cutting Charts**

*To cut a chart:*

1. Right-click the chart template.

2. Click **Cut Chart** from the menu that displays.

   The cut chart highlights in red in the Analysis Tree until it is pasted into a new mission. Once pasted, the cut chart disappears from its original location.

**Pasting Charts**

Charts can be copied or cut, then pasted into other missions.

*To paste a chart:*

Right-click the chart node in the Analysis Tree to which you want to paste the cut or copied chart, and then select **Paste Chart** from the menu which displays.

The chart appears below the destination Chart node. If you used the Cut command, the cut chart will be removed from its previous location.
Deleting Charts

*To delete a chart:*

Do one of the following:

- Right-click the chart in the Analysis Tree, and then select *Delete Chart* from the menu that displays.
- Select the chart in the Analysis Tree, and then select the *Delete* button on the keyboard. When prompted, click *Yes* to delete the selected chart.

The selected chart disappears from the Analysis Tree.

Cultural Templates

Once you have created the basic task network model for your analysis, you can use cultural modeling to further define your model. Cultural modeling is *the application of cultural or country based influences on human behavior or performance within a human performance model*. Given a situation with the same physical conditions and the same resources, people from different cultures or countries may react to the situation and apply their resources differently. A cultural difference exists when the average reaction of a population from one culture differs from that of another.

IMPRINT Pro allows users to create and save profiles, or templates, which define the relevant cultural properties for each culture modeled and the values derived from cultural data that are assigned to those properties. One or more templates can be defined by the user. At execution time, the user selects the template that is to be used.

Adding Cultural Templates

*To add a cultural template:*

1. Right-click the **Cultural Templates** node in the Analysis Tree.
2. Select **Add Cultural Template** from the menu that displays.

A new Cultural Template displays below the Cultural Template node in the Analysis Tree.

---

**Note:**
IMPRINT Pro names the new cultural template Cultural Template. If you continue to add cultural templates, the new cultural template will be named Cultural Template1 and each following is numbered, increasing by one for each addition. You can edit the name of the cultural template in the Cultural Template Properties dialog box in the main window or the Cultural Template Properties window name box.

---

### Displaying Cultural Templates

You can display a list of cultural templates associated with the mission in the Analysis Tree below the Cultural Template node and in the main window.

**To display a list of cultural templates in the Analysis Tree:**

Click the + adjacent to Cultural Template node.

A list of defined cultural templates displays below the Cultural Template node.

**To display cultural templates in the main window:**

In the Analysis Tree, double-click the Cultural Template node.

This action will display a list of Cultural Templates in the main window.
Cultural Template Properties

When building a cultural profile, select the cultural properties that are affected by a selected culture, and assign the appropriate values for those properties based on the cultural data. IMPRINT Pro also allows you to specify default values for each cultural parameter. The default value is used when cultural data for a parameter is not available.

Use the cultural template dialog box to edit the cultural template name, to add or delete cultural parameters, and to set values.

**To display Cultural Template Parameters:**

Double-click of the cultural templates listed below the Cultural Template node in the Analysis Tree.

The Cultural Template Parameter dialog box displays.
Adding Cultural Parameters

Before you can add a cultural parameter, you must create a list of variables whose Cultural option is set to True. This option appears at the bottom of the Variables dialog box for any selected variable. If no variable’s Cultural flag is set to True and you attempt to add a cultural parameter, you will get an error message telling you that IMPRINT Pro is unable to add a new Cultural Template Parameter. Furthermore, you will not be able to proceed any further in creating your cultural parameter.

To add a parameter:

Do one of the following:

• Click the Add Parameter button, and then click the drop-down arrow and select a parameter from the list.

• Right-click the cultural template in the Analysis Tree, and then select Add Parameter from the menu that displays.

A new Cultural Parameter displays in the Cultural Parameter dialog box. You may change the variable in the parameter box by clicking in the box, clicking the drop-down arrow on the right side, and then selecting a new variable from the list which displays.

Copying Cultural Templates

To copy a cultural template:

1. Right-click the cultural template.
2. Select **Copy Cultural Template** from the menu that displays.

Once you have copied the cultural template, you can paste to a Cultural Template node in another analysis.

**Cutting Cultural Templates**

*To cut a cultural template:*

1. Right-click the cultural template.
2. Click **Cut Cultural Template** from the menu that displays.

The cut cultural template highlights in red in the Analysis Tree until it is pasted into a new mission. Once pasted, the cut cultural template disappears from its original location.

**Pasting Cultural Templates**

Cultural templates can be copied or cut, then pasted into other missions.

*To paste a cultural template:*

Right-click the cultural template node in the Analysis Tree to which you want to paste the cut or copied template, and then select **Paste Cultural Template** from the menu that displays.

The cultural template appears below the destination Cultural Template node. If you used the Cut command, the cut template will be removed from its previous location.

**Deleting Cultural Templates**

*To delete a cultural template:*

Do one of the following:

- Right-click the cultural template in the Analysis Tree, and then select **Delete Cultural Template** from the menu that displays.
- Select the cultural template in the Analysis Tree, and then select the **Delete** button on the keyboard.

The selected template disappears from the Analysis Tree.
Comments

You can use comments to add clarification to the network diagram and to display values of variables on the network diagram as the mission runs. For example, you could place the name, description, and last revision date of the mission as a title on the network diagram. You could also place comments describing the different path logic in places where you had a decision node with multiple path routing. The following illustration shows the use of comments in the title and in path routing.

You can position comments in the same way as any other network object. A list of comments associated with the mission displays in the Analysis Tree below the Network node. You can display comment descriptions and add, edit, and delete comments.

Adding Comments

To add a comment:

Do one of the following:

• From the Palette, drag the Comment object to a location on the Network Diagram.

• Right-click in the network diagram, and select Add Comment from the menu that displays.

A new comment object appears in the Network Diagram; a new comment node appears in the Analysis Tree.
Displaying Comment Text

To display a comment text:

On the Network Diagram or in the Analysis Tree, double-click the
comment.

The Comment dialog box displays in the main window.

Adding Variables to Comments

The Comment box can be used to display variables on the network
diagram during mission execution. As an example, you might want to
display the rate of entities arriving at a task and the size of a queue as the
mission executes.

Before you can add a variable to the comment box, you must create a list
of variables below the Variables node. If you attempt to add more variables
to the comment display than are available, you will get an error message
telling you that IMPRINT Pro is unable to add a new variable.
To add a variable to the comment:

Click the Add Variable button.

A variable will be added from the list defined variables below the Variables node.

To change the variable:

1. Click the new variable in the box to display the drop-down arrow.
2. Click the drop-down arrow to select from a list of available variables.
3. Select a new variable from the list.

The next time you execute the mission, the comment box will display the variables you have selected and their respective values.

Editing Comments

To edit a comment:

1. On the network diagram, double-click the comment.

   The Comment dialog box displays in the main.

2. Click in a box and make your changes.

Deleting Comments

To delete a comment:

1. On the network diagram, select the Comment box.

2. Do one of the following:
   • Right-click the comment in the Analysis Tree, and then select Delete Comment from the menu that displays.
   • Press the Delete button.

   The comment is deleted.
Workload Monitors

Workload monitors display or “monitor” the ongoing workload values for any operator. They appear as green boxes in the Network Diagram, displaying the Warfighter being monitored, that same Warfighter’s total workload at an instant in time, and the total number of ongoing tasks he or she is performing at the time which are contributing to the workload value. A separate workload monitor is required for each operator whose current workload you wish to display.

You can position workload monitors in the same way as any other network object. A list of workload monitors associated with the mission displays in the Analysis Tree below the Network node. You can add, edit, display and delete workload monitors.
Adding Workload Monitors

To add a workload monitor:

Do one of the following:

- From the Palette, drag the Workload Monitor object to a location on the Network Diagram.
- Right-click in the network diagram, and select Add Workload Monitor from the menu that displays.

A new workload monitor object appears in the Network Diagram; a new workload monitor node appears in the Analysis Tree.

Displaying Workload Monitors Properties

To display workload monitor properties:

On the Network Diagram or in the Analysis Tree, double-click the workload monitor whose properties you wish to view.

The workload monitor dialog box displays in the main window. The only property describing the workload monitor is the Warfighter whose workload you wish to display. This information displays in the Warfighter field.
Changing the Workload Monitor Warfighter

Workload monitors contain a single editable field which displays the Warfighter whose workload you wish to display. You may change the designated Warfighter to any other Warfighter defined as an Operator in your analysis.

To change the workload monitor warfighter:

1. Double-click the workload monitor in the Analysis Tree or in the Network Diagram to open the Workload Monitor dialog.

2. The Workload Monitor dialog displays.

3. Click the drop-down arrow next to the Warfighter field to select from a list of available operators.

4. Select a new Warfighter from the list.

   The Warfighters field updates to display the newly selected Warfighter whose workload will display in the Network Diagram window.

Copying Workload Monitors

To copy workload monitor:

1. Right-click the workload monitor.

2. Select Copy Workload Monitor from the menu that displays.

   Once you have copied the workload monitor, you can paste to the Network node or in the network diagram of another analysis.
Cutting Workload Monitors

To cut a workload monitor:

1. Right-click the workload monitor.

2. Click Cut Workload Monitor from the menu that displays.

   The cut workload monitor highlights in red in the Analysis Tree until it is pasted into a new mission. Once pasted, the cut workload monitor disappears from its original location.

Pasting Workload Monitors

Workload Monitors can be copied or cut, then pasted into other missions.

To paste a workload monitor:

Right-click the Network node in the Analysis Tree to which you want to paste the cut or copied workload monitor, and then select Paste Node(s) from the menu that displays.

The workload monitor appears below the Network node in the destination analysis. If you used the Cut command, the cut workload monitor will be removed from its previous location.

Deleting Workload Monitors

To delete a workload monitor:

1. On the network diagram, select the workload monitor to be deleted.

2. Do one of the following:
   • Right-click the workload monitor in the Analysis Tree, and then select Delete Workload Monitor from the menu that displays.
   • Press the Delete button.

   The workload monitor is deleted.
Subchapter 5.3 Creating Missions with the Mission Means Framework (MMF) Mission Builder

As an alternative to creating a mission within the IMPRINT Pro application, you may begin to configure missions using the Mission Means Framework, or MMF Mission Builder. The MMF Mission Builder is an external application which allows you to enter basic task-type data which can later be imported into IMPRINT Pro. The MMF Mission Builder offers the following advantages:

- Basic mission-level data may be entered by users who do not have access to a copy of IMPRINT Pro but wish to create the starting framework of a mission model including missions, tasks, functions and operators.

- The MMF Mission Builder includes the pre-defined Universal Joint Task Lists, or UJTLS, which may be incorporated into your IMPRINT Pro model. Tasks may be imported in sets or individually.

Data created by this tool exports to an .xml file which can then be imported into IMPRINT Pro as a new analysis or as new data to an existing analysis. Following the import, paths and logic must then be added to your model using the Network Diagram, Properties window and/or informational tabbed windows for the nodes in your model.

Installing the MMF Mission Builder

In order to use the MMF Mission Builder, you must first install it on your computer.

To install the MMF Mission Builder:

1. Locate the MMFBuilder.msi installer file included with your installation of IMPRINT Pro. This file may be found in the following directory once IMPRINT Pro is installed:

   C:\Program Files\IMPRINT Pro 3.0\MMF Mission Builder Setup

   Alternatively, the setup.exe file may be used to install the MFF Mission Builder.
2. Double-click this file.

The installer launches.

3. In the Select Installation Folder dialog, click Next to install the MMF Mission Builder to the default folder listed in the Folder field.

Alternatively, you may click the Browse button to install the application to a different folder on your system.

You may also choose to have the MMF builder available to “Everyone” using the computer or to just your own user account by clicking the corresponding radio button in the section below the Folder field.
4. Click **Next**.

The **Confirm Installation** dialog appears. Do one of the following:

- Click **Cancel** to exit out of the MMF Mission Builder installation.
- Click **Back** to go back to a previous page in the installation wizard.
- Click **Next** once again to proceed with the installation with all selected settings.
Upon clicking **Next**, the installation proceeds. Once the installer finishes a message displays, indicating the install is complete.
Note:
To ensure your installation of the MMF Mission Builder includes all the latest files, you will be prompted to remove any previously-installed versions of the MMF Mission Builder, if any exist, before installing or updating to the latest version.

To start the MMF Mission Builder:

1. Navigate to the MMF Mission Builder icon on your system’s desktop.

2. Double-click the MMF Mission Builder icon to launch the application.

   The MMF Mission Builder launches.
Chapter 5: Mission Analysis

MMF Mission Builder Window Overview

The default configuration for the MMF Mission Builder window consists of a container window with a title bar, menu bar and status bar at the top. Further down inside the container window, separate data windows and their own tool bars display for your Operators lists and Purpose/Mission lists.

✓ Note:
   Many of the windows within the MMF Mission Builder are blank until you begin to add data.

The following illustration shows the components of the MMF Mission Builder window. Each of these components is described in greater detail in the remaining sections of this chapter.
MMF Mission Builder Window Components

This section describes the window components in the MMF Mission Builder window.

The MMF Mission Builder window has the following components:

- Title Bar
- Menu Bar
- Status Bar
- Data Windows
- Tool Bar
Title Bar

The title bar displays at the very top of the IMPRINT Pro window and contains the name and version of the currently open analysis.

Menu Bar

The menu bar displays below the title bar at the top of the IMPRINT Pro window and contains a single menu named File. The File menu includes the following basic commands:

- **New.** Create a new template for export.
- **Open.** Open an existing template.
- **Save.** Save your template data to file for continued editing in a later session of the template or for importing into IMPRINT Pro.
- **Save As.** Save your template data to a new file name.
- **Exit.** Exit the application.

Status Bar

The Status Bar displays helpful messages about the status of your mission.
Data Windows

The MMF Mission Builder data windows are used for adding and editing your MMF data. There are two tabs contained within this part of the window:

- **Operators**. Use this tab to add, delete and display both Personnel and Materiel operators. The specialty type for Personnel operators is set using fields in this tab.

- **Purpose/Mission**. Use this tab to add, delete and display Purpose/Mission data, including missions, functions, goals and tasks.

Tool Bar

The MMF Template tool bar displays inside the Data Windows and provides quick access to commonly used commands. This tool bar is available for the Operators tab only. However, separate tool bars exist for the Personnel section and the Materiel section of the Operators Window. Each command displays as a button on the tool bar which may be clicked to access the command. Options include:

- **Move First**. Select the first operator in your list.

- **Move Previous**. Select the previous operator in your list.

- **Move Next**. Select the next operator in your list.

- **Move Last**. Select the last operator in your list.

- **Add New**. Add a new operator.

- **Delete**. Delete the currently selected operator.

As you move the pointer over each button, a tooltip displays the corresponding command name.
Creating a Mission using the MMF Mission Builder

This section explains how to add elements to your mission using the MMF Mission Builder. For more information on each element see “Subchapter 5.2 Working With Missions” on page 106.

Understanding the MMF Mission Builder Elements

The MFF Mission Builder was designed as a means for incorporating Universal Joint Task List (UJTL) data into IMPRINT Pro. Therefore, many of the elements within the Mission Builder use naming conventions used by the UJTL, several of which vary from the conventional names used by IMPRINT Pro. When a data file from the MMF Mission Builder is imported into IMPRINT Pro, however, the names used by the MMF Mission Builder are then automatically translated into IMPRINT Pro names.

Knowing these translations, the MMF Mission Builder can also be used to create non-MMF missions for import into IMPRINT Pro. Use the guideline below to relate the MMF terms to IMPRINT Pro terms.

Table 1: MMF and IMPRINT Pro Terminology
<table>
<thead>
<tr>
<th>IMPRINT Pro Term</th>
<th>MMF Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis Name</td>
<td>Mission Context</td>
<td>This will become your IMPRINT Analysis Name. Can be a system (e.g. Tank) or mission area (e.g. Consequence Management Operations).</td>
</tr>
<tr>
<td>Warfighter/Operator</td>
<td>Human Component</td>
<td>This will equate to an operator within the Warfighters section of your analysis.</td>
</tr>
<tr>
<td>Warfighter/Operator</td>
<td>Materiel Component</td>
<td>This will equate to an automated operator within the Warfighters section of your analysis.</td>
</tr>
<tr>
<td>(automated)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mission</td>
<td>Purpose/Mission</td>
<td>This will become an operational mission within your IMPRINT Analysis.</td>
</tr>
<tr>
<td>Function</td>
<td>Function/Capability</td>
<td>High level actions that equate to requirements to deliver capabilities. Functions must contain at least one task, and can contain other functions. Most data entered in IMPRINT will not be entered at the function level.</td>
</tr>
<tr>
<td>Task</td>
<td>Task</td>
<td>This is the lowest level breakdown of steps to perform the mission. Human performance data, such as task time and mental workload, is included in tasks.</td>
</tr>
</tbody>
</table>
Knowing the IMPRINT Pro equivalents of the MFF Mission Builder data elements, the MFF Template can be used to create any generic analysis for IMPRINT Pro which might not be MFF-related. Simply refer to the guide above for the desired IMPRINT Pro data elements you wish to add to your mission and the name under which those elements can be found in the MMF Mission Builder.

### Required Data Elements

You may use the MMF Mission Builder to define all the available components it contains or to define only a subset of those components. If the components you wish to add comprise only tasks, you must first add at least one Human or Materiel Component under the Components tab to act as the default operator for those tasks when they are added and ultimately imported into IMPRINT Pro.

### Adding Components (Operators)

Components in the MMF Mission Builder are equivalent to “Operators” in IMPRINT Pro. At least one default component is required if tasks are to be added to your MMF mission. This component acts as the default component (and ultimately the default operator once imported into IMPRINT Pro) for all tasks until you reassign the task(s) to a different component. The default component may be either of type **Human** or **Materiel**.

**To add a component:**

1. Click the **Components** tab.
2. Choose the type of component you wish to add. Options include:

<table>
<thead>
<tr>
<th>IMPRINT Pro Term</th>
<th>MMF Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals</td>
<td>Leveraged Capabilities</td>
<td>These will become goal networks within your mission. They represent high level actions, similar to functions, that equate to deliver capabilities. Often times goals will represent responses to OPFOR actions or potential actions within a mission that will not always be performed.</td>
</tr>
</tbody>
</table>
- **Human Component.** Human Components in the MMF Mission Builder are the equivalent of “non-automated operators” in IMPRINT Pro.

- **Materiel Components.** Material Components in the MMF Mission Builder are the equivalent of “automated operators” in IMPRINT Pro.

3. Under the desired operator type, click the **Add New** button on the corresponding toolbar.

A new component appears in the window. All new Human Components are labeled “HumanComponent” by default, and all new Materiel Components are labeled “MaterielComponent” by default.

### Editing Components

Editable properties of Human Components include **name** and **specialty type**. For Materiel Components, only the name may be changed.
To edit a component name:
1. Double-click the component whose name you wish to change.
   The field changes to a text-editing field.
2. Type the desired name in the field.

To edit a component specialty:
1. Choose an component whose specialty you wish to change.
2. From the **Specialty** drop-down list on the right side of the selected component, click the drop-down arrow to view a list of available specialties from which to choose.
3. Select a new specialty for the selected component by clicking it.
   The **Specialty** field updates to display the new specialty.

Deleting Components

To delete a component:
1. Click the **Components** tab to display the list of components.
2. Select the component you wish to delete by clicking it.
3. Click the **Delete** “X” button on the toolbar.
   The selected component disappears from the list.

Adding Purpose/Missions (Missions)

Purpose/Missions in the MMF Mission Builder are the equivalent of “Missions” in IMPRINT Pro.

To add a purpose/mission:
1. Right-mouse click inside the **Purpose/Mission** window.
2. From the shortcut menu, select **Add Purpose/Mission**.
A new Purpose/Mission listing appears in the window. All purpose/missions added to the MMF Mission Builder default to “Mission”.

Editing Purpose/Missions

Editable properties of missions include the Mission/Purpose Name.

To edit a purpose/mission:

1. Select the mission to edit in the Purpose/Mission window by clicking it.
   The window on the right side displays the purpose/mission name.

2. Edit the purpose/mission name as desired by typing a new name in the field provided.

Note:
The Name property of the mission is the only mission-level property which can be altered.
Deleting Purpose/Missions

To delete a purpose/mission:

Right-click the mission you wish to delete in the Purpose/Mission window.

From the shortcut menu that appears, select Delete.

The selected purpose/mission disappears from the window.

Adding Function/Capabilities (Functions)

Function/Capabilities in the MMF Mission Builder are the equivalent of “Functions” in IMPRINT Pro.

To add a function:

1. In the Purpose/Mission window, right-click the mission to which a new function should be added.

2. From the shortcut menu that appears, select Add Function/Capability.

The new function/capability is added underneath the selected mission. All function/capabilities added to the MMF Mission Builder default to “Function”.

3. Click the plus “+” sign next to the selected mission.
The new function/capability appears at the next level below the mission.

**Editing Function/Capabilities**

Editable properties of function/capabilities include the **Function/Capability Name**.

**To edit a function/capability:**

1. Select the function/capability to edit in the **Purpose/Mission** window by clicking it.

   The window on the right side displays the function/capability name.

2. Edit the function/capability name as desired by typing a new name in the field provided.

   **Note:**
   The **Name** property of the function/capability is the only Function-level property which can be altered.

**Adding Leveraged Capabilities (Goals)**

Leveraged Capabilities in the MMF Mission Builder are the equivalent of “Goals” in IMPRINT Pro.

**To add a leveraged capability:**

1. In the **Purpose/Mission** window, right-click the mission to which a new leveraged capability should be added.

2. From the shortcut menu that appears, select **Add Leveraged Capability**.
The new leveraged capability is added underneath the selected mission.

3. Click the plus “+” sign next to the selected purpose/mission.

The new leveraged capability appears at the next level below the mission. All leveraged capabilities added to a mission are initially labeled “Goal”.

**Editing Leveraged Capabilities**

Editable properties of leveraged capabilities include the **Name** property.

**To edit a leveraged capability:**

1. Select the leveraged capability to edit in the **Purpose/Mission** window by clicking it.

    The window on the right side displays the leveraged capability name.
2. Edit the leveraged capability’s name as desired by typing a new name in the field provided.

✓ Note:
The Name property of the leveraged capability is the only property which can be altered.

Adding Tasks

Tasks in the MMF Mission Builder are the equivalent of “Tasks” in IMPRINT Pro.

To add a task:

1. In the Components tab add a new component if one does not already exist.

   At least one component is required in any MMF Mission Builder analysis that has tasks in order that a default component may be assigned to these tasks as they are added. This assignment may be changed to a different component at any time.

2. In the Purpose/Mission window, right-click the mission or function below which a new task will be added.

3. From the shortcut menu that appears, select Add Task.

   ![Shortcut Menu]

4. Click the plus “+” sign next to the selected mission/function.

   The new task appears at the next level below the mission/function.
Task Properties

To view task properties:

Click a task in the Purpose/Mission tree.

Properties for the selected task appear in the pane to the right.

Editable task properties include the following:

- **Name.** The name of the selected task.
- **Mean Time.** The average duration of the selected task.
- **Standard Deviation.** Optional variability which may be factored into the selected task’s time.
- **Primary Operator.** The operator performing the task.
Single Task Demands. The amount of workload the task demands over the seven default resources-interface channels.

Editing Tasks

To edit a task:

1. Select the task you wish to edit by clicking it in the window on the left.

   The properties for the selected task appear in the window on the right.

2. Edit the properties of the selected task as desired by selecting from or by typing directly in the fields provided.

Adding tasks from the Universal Joint Task List (UJTL)

The Universal Joint Task List is a set of universal pre-defined tasks which can be imported directly into your template. Tasks can be imported in groups categorized by Operational Area or by Levels of War or imported as individual tasks.

- **Operational Area.** A group of task which together comprise or help support a specific mission or operation to be used as the framework for mission analysis and structured training event.¹

- **Levels of War.** The Levels of War option contains four sub-categories of tasks: Strategic National, Strategic Theater, Operational Level, Tactical Level.

- **Individual Tasks.** Import any task from the UJTL template as a task or function in your template.

UJTL Tasks by Operational Area

Available operational areas include the following:

<table>
<thead>
<tr>
<th>Operational Areas</th>
<th>COUNTERTERRORISM</th>
<th>NUCLEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR ASSAULT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIRBORNE</td>
<td>DEFENSIVE COUNTER-AIR</td>
<td>OFFENSIVE COUNTERAIR</td>
</tr>
<tr>
<td>AMPHIBIOUS</td>
<td>DELAY</td>
<td>PEACE ENFORCEMENT</td>
</tr>
</tbody>
</table>

### Operational Areas

<table>
<thead>
<tr>
<th>ANTIUBMARINE WARFARE</th>
<th>DEPLOYMENT</th>
<th>PEACEKEEPING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTITERRORISM</td>
<td>DESTROY ENEMY BASES</td>
<td>PEACEMAKING</td>
</tr>
<tr>
<td>AREA DEFENSE</td>
<td>DESTROY ENEMY NAVAL FORCES</td>
<td>PURSUIT</td>
</tr>
<tr>
<td>ARMS CONTROL</td>
<td>DOMESTIC CONSEQUENCE MANAGEMENT</td>
<td>REAR AREA SECURITY</td>
</tr>
<tr>
<td>ATTACK</td>
<td>ENVIRONMENTAL ASSISTANCE</td>
<td>RECEPTION, STAGING, ONWARD MOVEMENT, AND INTEGRATION</td>
</tr>
<tr>
<td>BARRIER OPERATIONS</td>
<td>EXPLOITATION</td>
<td>RECONNAISSANCE, SURVEILLANCE</td>
</tr>
<tr>
<td>BLOCKADE</td>
<td>FOREIGN CONSEQUENCE MANAGEMENT</td>
<td>RETIREMENT</td>
</tr>
<tr>
<td>CAMPAIGN PLANNING</td>
<td>FOREIGN INTERNAL DEFENSE</td>
<td>SEARCH AND RESCUE</td>
</tr>
<tr>
<td>CIVIL DISTURBANCE</td>
<td>HUMANITARIAN ASSISTANCE</td>
<td>SEIZE ADVANCED BASES</td>
</tr>
<tr>
<td>CIVIL SUPPORT</td>
<td>INFORMATION WARFARE</td>
<td>SHOW OF FORCE</td>
</tr>
<tr>
<td>COMBAT SEARCH AND RESCUE</td>
<td>JOINT INTERDICTION</td>
<td>SPACE</td>
</tr>
<tr>
<td>COMMAND AND CONTROL WARFARE</td>
<td>MARITIME INTERCEPTION</td>
<td>STRATEGIC ATTACK</td>
</tr>
<tr>
<td>COUNTERDRUG</td>
<td>MOBILE</td>
<td>SUPPORT COUNTERINSURGENCIES</td>
</tr>
<tr>
<td>COUNTERPROLIFERATION</td>
<td>MOBILIZATION</td>
<td>SUPPORT INSURGENCIES</td>
</tr>
<tr>
<td>CAMPAIGN PLANNING</td>
<td>MOVEMENT TO CONTACT</td>
<td>SUPPRESSION OF ENEMY AIR DEFENSES</td>
</tr>
<tr>
<td>CIVIL DISTURBANCE</td>
<td>NATION ASSISTANCE</td>
<td>THEATER MISSILE DEFENSE</td>
</tr>
<tr>
<td>CIVIL SUPPORT</td>
<td>NONCOMBATANT EVACUATION</td>
<td>THEATER NUCLEAR</td>
</tr>
</tbody>
</table>

When importing a group of tasks by operational area, the “Operational Area” selected becomes a function in the template while all tasks contained by it become the function’s subfunctions and subtasks. Only those tasks which cannot be further broken down import as tasks.
UJTL Tasks by Levels of War

The Levels of War option contains four sub-categories of tasks:

<table>
<thead>
<tr>
<th>Level of War</th>
<th>Definitiona</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic National Military Tasks (SN)</td>
<td>Tasks which are national and Multinational level objectives and guidance which are accomplished by the development and use of national resources.</td>
</tr>
<tr>
<td>Strategic Theater Tasks (ST)</td>
<td>Tasks which foster the development of theatre plans used to achieve objectives and providing forces/capabilities in accordance with strategic plans.</td>
</tr>
<tr>
<td>Operational Level (OP)</td>
<td>Tasks which link tactics and strategy by establishing operational objectives, initiating actions and applying resources.</td>
</tr>
<tr>
<td>Tactical Level (TA)</td>
<td>Task which are built around planning and executing battles and engagements to accomplish military objectives. Each Service publishes a tactical task list.</td>
</tr>
</tbody>
</table>


Importing a Group of UJTL Tasks

To import a group of UJTL tasks:

1. If not already open, click the Purpose/Mission tab to access a list of missions in your template.

2. Select the mission into which you wish to import one or more UJTL tasks.

3. Right-mouse click the desired mission.

   From the shortcut menu that appears, select Import UJTL Tasks...
4. In the UJTL Dialog box, select one of the following:
   - Levels of War
   - Operational Area

   All task subgroups belonging to the selected group appear in the panel on the right.

5. Select a level of war or operational area which include the tasks you wish to add to your data file.

   The selected level and all tasks below it are added to your mission data file.
6. Click **Ok**.

The tasks corresponding to the selected Level of War or Operational Mission appear in the Purpose/Mission Tree.

Tasks may also be selected individually. To select an individual task simply navigate down to the lowest level in the selected subgroup, and then choose the task to add.

**Saving Template Data**

*To save template data:*

1. From the **File** menu option, select **Save**.

   A **Save As** dialog box appears.
2. In the **Save In...** field at the top, browse to the location on your system where you wish to save your file.

3. In the **File Name** field, enter a name for your template data file.

4. Click the **Save** button.

The template data saves to the specified name and location with a .mff file extension. This file can be opened in future sessions of the MMF Mission Builder application or may be imported directly as a new analysis in IMPRINT Pro using the **New Analysis from Imported Data** option from the **File** menu or Analysis Tree. The file may also be imported into an existing analysis using the **Import Data** option available by right-mouse clicking on any analysis in the Analysis Tree.

**Importing MMF Mission Data into IMPRINT Pro**

The .xml file to which MFF Mission Builder data saves can be imported directly into IMPRINT Pro either as a new analysis or into an existing analysis.

**Importing MMF Data as a New Analysis**

*To import an MMF Mission Builder data file as a new analysis:*

1. Open IMPRINT Pro.

2. From the **File** menu select **New Analysis from Imported Data**.

3. In the submenu that appears, select **From MMF Data**.

4. In the submenu that appears, select **Local Server**.

5. From the Local Server submenu, choose the folder on your local server in which the new analysis should be added.

6. In the dialog box provided, browse to the location of your MMF data file.

7. Select the desired file, and then click **Ok**.

IMPRINT Pro imports the selected template data file. All imported data may be viewed in the analysis tree under the analysis name you specified in your template.
Importing MMF Data into an Existing Analysis

To import an MMF Mission Builder data file into an existing analysis:

1. Open IMPRINT Pro.

2. Choose an analysis in the analysis tree into which a data file from the MMF Mission Builder will be imported.

3. Right-mouse click the desired analysis. From the shortcut menu that appears, select **Import Data**.

4. From the shortcut menu that appears, select **MMF Data**.

   A browse dialog box appears.

5. In the browse dialog box, select the desired file for import by clicking it.

6. Click the **Open** button.

   IMPRINT Pro proceeds to import the MMF Mission Builder data file.

   Once IMPRINT Pro has finished importing the MMF Mission Builder data file a message displays, indicating the import was successful. The imported data then appears in the analysis tree under the selected analysis.

To import an MMF Mission Builder data file as a new analysis:

1. Open IMPRINT Pro.

2. From the **File** menu select **New Analysis from Imported Data**.

3. From the submenu that appears select **MMF Data**.

4. From the submenu that appears select **Local Server**.

5. From the submenu that appears select the folder in the analysis tree to which the new analysis should be added.

   A browse dialog box appears.

6. In the browse dialog box, select the desired MMF Mission Builder data file (.mmf) for import by clicking it.
7. Click the **Open** button.

IMPRINT Pro proceeds to import the MMF Mission Builder data file.

Once IMPRINT Pro has finished importing the MMF Mission Builder data file a message displays, indicating the import was successful. The imported data then appears in the analysis tree under the selected analysis.

---

**Subchapter 5.4 Running the Mission**

Once you have created a mission and defined the mission properties, you are ready to run the mission. Execution options allow you to start, resume, pause, or halt mission execution; step through mission execution one event at a time; and change the speed of execution.

This chapter also contains a discussion of potential sources of errors in logic and syntax that may affect mission execution and describes how to use the syntax checker provided by IMPRINT Pro to correct them.

---

**Displaying the Execution Settings**

Execution settings are found underneath the Execution menu. You have the option of selecting settings for an Operational model or Maintenance model at the top of the Settings dialog box.

In an Operations model, the settings control the number of runs for the mission, the random number seed, the collection of PTS Adjustments, Perfect Accuracy, and Workload Strategies data. You will also have the option of running the mission with the Cultural Templates option checked.

**To display execution settings:**

From the main menu, select **Execution**, and then select **Settings**.

The Execution Settings dialog box displays.

✓ **Note:**
By default, the Execution Settings window displays the Maintenance Model settings. All Operations Model settings, however, are grayed out until an Operation mission has been selected from the Analysis tree.
Editing Execution Settings

Execution settings should be checked prior to running a model. Execution Settings are saved as part of the model settings at the mission level.

To edit execution settings:

1. From the main menu, select Execution, and then select Settings.

   The Execution Settings dialog box displays.

2. Edit the execution properties as desired.

Execution Setting Properties

You can use IMPRINT Pro to create and execute two types of models:

- **Operations Model.** An Operations model is used to estimate the workload associated with the performance of a new weapon system. This is accomplished by building a task network of each operational mission that the system will be required to accomplish.

- **Maintenance Model.** The Maintenance model is used to estimate maintenance man-hour requirements for a given scenario in order to attain acceptable system availability.

Operations Model Execution Properties

Following is a detailed description of the settings properties for an Operations model.

- **Number of times to run the mission.** Set this box to the number of times to run the mission. If the number is greater than one, the execution times, paths of execution, and other probabilistic events are will vary for each run based on the distribution you have entered.

- **Random Number Seed.** Set this box to the number IMPRINT Pro should use to generate random numbers for calculating task execution times and taking probabilistic paths through the network. The random number seed is a number between approximately -2 billion and +2 billion (inclusive). The same seed always produces the same set of random numbers in the same order, and thus the same results.


- **PTS Adjustments.** Check this box to use the task times and accuracies that were adjusted as a result of the combined applied Personnel Characteristics, Training Frequencies, and Stressors on the Calculator menu.

- **Perfect Accuracy.** Check this box to run the model in a setting of perfect accuracy in which case the probability of success for every task is automatically assumed to be 100%. Because it is impossible for any task to fail under this condition, any failure consequences set for a task will not be exercised as a result.

- **Workload Strategies.** Check this box to enable the workload strategies defined for each Operator Warfighter in the Analysis Tree, described in the Workload Management in “Warfighter Data” on page 67.

- **Animation On.** The Animator window displays a two-dimensional graphical depiction of your model as it executes. The data displayed in the Animator window depends on the model type you choose to run: if an operational mission is selected, the Animator window displays workload data for crew members in your operational mission; if a maintenance scenario is selected, the Animator window displays queue data, combat data, reliability and availability data and maintenance summary data for the scenario. Before enabling this option, go to the **Windows** option under the **View** menu, and select the **Animator** option to add the display window to your current layout.

- **Cultural Modeling.** Check this box to select different cultural templates to apply to the model as it runs.

### Executing the Operations Model

*To execute the operations model:*

1. Select a mission below the Mission node in the Analysis Tree.

2. From the **Execution** menu, select **Settings**.

3. If not already selected, click the **Operations Model** tab near the top of the Settings dialog box.

   IMPRINT Pro loads the data for the currently-selected operations mission model; the mission name appears at the top of the dialog box.
4. Edit the execution settings as desired.

5. To begin execution of the mission do one of the following:
   • From the **Execution** menu, select **Begin Simulation**.
   • Click the **Begin Simulation** button on the tool bar.

✓ Note:
Unlike previous IMPRINT models which end when the first entity reaches the Ending Effect of the Model End task (999), all models in this version and forward will continue to run as long as there are items in the Event Queue. If you wish to simulate the behavior of older versions of IMPRINT Pro, you must explicitly add the call `Model.Halt();` in the Ending Effect of Task 999.

**Viewing Operations Model Data During Execution**

IMPRINT Pro uses several different windows to display model data during execution. Some windows show the values of chosen variables while others display logic errors, such as an array index out of bounds or division by zero. IMPRINT Pro also includes several built-in tools to quickly locate, debug and correct these errors in the model.
Network Diagram. The Network Diagram displays the network of tasks and functions comprising your mission in the form of differently-colored shapes known as "nodes". Nodes highlight as entities pass through them model run. The Network Diagram also displays paths to show the relationship between the various nodes. Use this display to check the sequencing of your tasks and to check path logic.

Animator Window. The Animator Window displays operator workload data during an operations model run. Use this display to check for unevenly distributed workload among operators, excessively high workload values encountered by any single operator and the effect of workload strategies.

Output Tab. The Output window displays messages about actions which occur during a model run. Any syntax errors are indicated and may be useful for debugging your model.

Event Queue Tab. The Event Queue window allows you to view the events as they occur. Events are labeled by Name, ID, Group, Tag and Time. Change the execution speed to a slower speed if the model executes too quickly for you to observe the events as they occur.

Variable Watches Tab. This window allows you to select the variables you want to monitor during model execution and create a watches for them. The Watch displays the variable name, value and variable type.

Search Tab. The Search window lets you search the entire model or selected components for a string of text.

Comment. Comment boxes can display the values of variables you select or text strings you specify inside a Comment box in the Network Diagram.

IMPRINT Pro displays the Output, Variable Watches, Event Queue, and Search windows in the same window below the IMPRINT Pro main window. Each window has a tab assigned to it. You can display any of the four windows by clicking on the appropriate tab. You can close any of the windows by clicking the in the upper right hand corner. See below for a complete description of the Output, Variable Watches, Event Queue, and Search tabs.
Network Diagram

The Network Diagram allows you to watch entities moving through the task network - this is known as **Network Animation**. When an entity is in a task or function, the task or function highlights in blue as beginning effect of that task (or any subtask belonging to the function) is evaluated. The number of entities in a task or queue are indicated by numbers that display above the task.

In the sample task network below, Task 3 has two entities actually in the task while five entities are waiting in queue to enter the task.

Enabling the network animation can cause a model to run more slowly. In the event you wish to speed up your model run, disable the network animation by closing or hiding the Network Diagram window.

Animator Window

The Animator Window displays Warfighter data during an operations model run. This data includes the following:

- **Workload Value**. The amount of workload the operator is currently taking on is indicated by a colored bar on a scale.

- **Maximum Workload Value**. This value is the maximum amount of workload an operator has encountered over all points in the model run thus far.

- **Number of Active Tasks**. The number of task an operator is performing at the present moment in the model run.

- **Active Workload Strategy**. The Animator Window displays the default workload management strategy assigned to the operator and/or strategy C if it overrides the default. Strategy C will override strategies E and F in the event an overload condition occurs and a contingency operator is not assigned.
**Workload Threshold.** The workload threshold assigned to an operator in his or her Warfighter properties window displays as a red line at the corresponding point along the operator’s workload scale. The exact threshold value displays next to it.

![Workload Threshold Diagram]

**Output Tab**

The Output window displays the actions that just finished happening in a running mission. These actions, known as Trace Data, display as follows:

- Clock values for beginning effects
- Clock values for ending effects
- Clock values for external events
- Syntax errors
- Whether or not the plugins are successfully loaded when IMPRINT Pro is started
- Application errors

When a run begins and completes, the following messages will display:

- **Simulation Complete.** An indication that the model run was successful and that reports are available for viewing.
Duration. The time required to process all model runs since the last time the Begin Simulation button was pressed.

Clock. The amount of time the model ran within the context of the mission or scenario. For example, if you run a scenario for 3.00 days in the Execution Settings window, the Clock time reported would be 72.00 hours.

Displaying Trace Data

To display trace data in the Output window:

1. From the View menu, click Windows, and then click Output from the menu that displays.

2. Under the Utilities menu, click the Display Trace option to enable it (a check mark next to the option ensures it is enabled.)

3. From the Execution menu, click Begin Simulation.

As the mission runs the trace data displays in the Output window.

✓ Note:
If the Display Trace option is disabled during the model run, the Output window will report minimal information about the model run.
Saving Trace Data Output to File

You can save the results in the Output window to a file, save the results to the Windows clipboard, and clear the data in the window.

*To save Output to file:*

1. Right-click the Output window.

2. Select *Save Output to File* from the menu that displays.

   The Save As dialog box displays.
3. Select the destination of the folder from the **Save in** box.

4. Type a file name in **File name** box.

5. Click **Save**.

The contents of the Output window save to a file on your system.

**Copying Trace Data Output to Clipboard**

*To copy output to Windows clipboard:*

1. Right-click the Output window.

2. Select **Copy Output to Clipboard** from the menu that displays.

The contents of the Output window automatically copy to the Windows clipboard. You can then paste the data to an external application.

**Copying Selected Trace Data Output**

This option can be used to save specific sections of the Output window as desired.
To copy selected output:

1. Select the trace date you want to copy by highlighting it in the Output window.

2. Right-click the Output window.

3. Click **Copy Select Output** from the menu that displays.

The data copies to the Windows clipboard. You can then paste the data to an external application.

Clearing the Output Window

With each consecutive model run, IMPRINT Pro clears the results from all previous model runs in the Output window. You may, however, clear the results in the Output window at any time independent of running the model.

To clear the Output window:

Do one of the following:

- Right-click the Output window and click **Clear Output** from the menu that displays.
- From the **Edit** menu click **Clear Output**.
- Press the shortcut keys **Ctrl+Shift+L**.

The Output window clears.

Event Queue Tab

The Event Queue window displays the list of events as they occur during model execution. These events include the execution of tasks, Beginning and Ending effects within a task, and any defined scheduled events. Each event listed is color coded as shown in the following table.
The type of Event, ID, Group, Tag, and Time display.

### Viewing Execution of External Events

**To view the execution of external events:**

1. Do one of the following:
   - From the **View** menu, click **Windows**, and then select **Event Queue** from the menu that displays.
   - Click the Event Queue tab from the bottom of the Output window area.

2. Execute the model by selecting the **Execution** menu and clicking **Begin Simulation**. Alternatively you may click the Begin Simulation button on the tool bar.

Events display in the Event Queue window as the model runs.
Variable Watches Tab

As an added method of debugging your model, IMPRINT Pro includes the Variable Watches window. This window allows you to select the variable whose value you want to monitor during model execution and create a Watch for it. The Watch displays the variable name, value and variable type.

Adding Watches

To add a watch:

1. Do one of the following:
   
   • From the View menu, select Windows, and then click Variable Watches from the menu that displays.
   
   • Click the Variable Watches tab from the bottom of the Output window area.

   The Variable Watches window displays.
2. Click the cell below the name box to type the name of the variable.

You can only create a watch for a defined variable. If you enter the name of an undefined variable, the watch is ignored.

You can enter specific array values for a variable name. For example, if you have an array named ArrayName in the task network, you can specify a particular item in the array such as ArrayName[5]. For the purpose of a watch, the index must be an integer constant value and not a variable (for example, ArrayName[Variable] is not valid).

3. From the Execution menu, click Step Simulation.

4. Press the shortcut keys Ctrl+T to step through the simulation.

Variable values and types display in the Variable Watch box.
Chapter 5: Mission Analysis

Editing Watches

To edit a watch:

1. From the View menu, select Windows, and then click Variable Watches from the menu that displays.

The Variable Watch window displays.

2. Click the cell of the variable whose watch you want to edit, and edit the variable name as desired.

Deleting Watches

To delete a watch:

1. From the View menu, select Windows, and then click Variable Watches from the menu that displays.

The Watch window displays.

2. Press the Delete key on the keyboard.

The watch is deleted.
Search and Replace Tab

The Search provides the option for locating strings of text in the model. You may either search the entire model or select components only. The components you can search depend on the type of model (Maintenance or Operations) that is checked in the Execution Settings window. Components available for search in the Operations model are:

- Everything (all components)
- Warfighters
- RI Pairs
- Resources
- Interfaces
- Goals, Functions, and Tasks
- Macros
- Snapshots
- Variables
- External Events
- Cultural Templates

Displaying the Search window

To display the Search window:

Do one of the following:

- From the View menu, select Windows, and then click Search from the menu that displays.
- Select the Search tab at the bottom of the Output window.

The Search window displays.

Searching in an Operations Model

If you are running an Operations model, the Search options for the Operations Model display.
Searching for Text

To search for text:

1. In the Find What box of the Search window, type the text string you want to find.

   By default, the search feature is not case-sensitive. Check the Match Case box if you want to find a string with the same capitalization (for example, Time is different than time).

   Space characters are allowed in the string.

2. In the Look In section, select the model elements to search by clicking the adjacent box(s).

3. Click the Find button.

   IMPRINT Pro searches for the text string and displays each occurrence of that string in the field on the right side of the Search window.

   You can stop the search at any time by clicking the Stop Search button.

4. Click ✗ to close the Search dialog box.
Checking for Syntax Errors

IMPRINT Pro allows you to check your model for syntax errors using the Check for Errors option located in the Execution menu and the tool bar. The Syntax Checker scans the entire model and immediately reports any errors in the Output window.

To check for syntax errors:

1. From the View menu, select Windows, then click Output.

   The Output window displays.

2. Do one of the following:
   • From the Execution menu, click Check for Errors.
   • Click the Check for Errors button on the tool bar.

   Any errors that are detected display in the Output window.

3. To open the dialog box where the error occurs, double-click the error.

   IMPRINT Pro generally indicates the nature of the problem in the error message, such as “unrecognized word” for a misspelled or undeclared variable or macro, or “semicolon expected at end” for a missing semicolon.

   Common problems include typographical errors in an expression, omitting a semi-colon, forgetting to define a variable or using the wrong case for a variable name. Because IMPRINT Pro distinguishes between upper and lower case letters, name, NAME, and Name are considered to be different and unique variables.

   For more information on common syntax errors and possible solutions, see IMPRINT Pro User’s Manual Volume 3, Appendix: Checking for Errors.

Controlling Execution

IMPRINT Pro provides commands to start, stop, pause, resume, and step through execution of a model. You can also set the speed for mission execution.
Starting and Resuming Mission Execution

To start or resume mission execution:

Do one of the following:

- From the Execution menu, click Begin Simulation.
- Click the Begin Simulation button on the tool bar.
- Press the shortcut keys Ctrl+G.

The mission executes or resumes execution.

✓ Note:
Before executing the mission, check the execution preferences to make sure the model is set to run as desired.

Pausing Mission Execution

You can temporarily pause mission execution. When mission execution is paused, you can make changes to the model attributes such as the values of variables.

To pause mission execution:

1. To pause mission execution do one of the following:
   - From the Execution menu, click Pause Simulation.
   - Click the Pause button on the tool bar.
   - Press the shortcut keys Ctrl+P.

   The mission pauses executing.

2. When you are ready to resume mission execution, click Begin Simulation from the Execution menu.

Stepping Through Mission Execution

You can step through mission execution one event at a time. This method of execution is useful for debugging a mission. This command is available only when the mission has not yet begun execution or when mission execution is paused.

To step through mission execution:

1. Do one of the following:
• From the **Execution** menu, click **Step Simulation**.
• Click the **Step Simulation** button on the tool bar.
• Press the shortcut keys **Ctrl+T**.

IMPRINT Pro executes the next event and pauses.

2. Select **Step Simulation** again.

IMPRINT Pro executes the next event and pauses.

3. To resume continuous execution, click **Begin Simulation** from the **Execution** menu.

**Stopping Mission Execution**

You can stop the current execution of a mission at any point. When you halt mission execution, *it cannot be resumed*. The run is terminated and must start over.

**To stop mission execution:**

Do one of the following:
• From the **Execution** menu, click **Halt Simulation**.
• Click the **Halt Simulation** button on the tool bar.
• Press the shortcut keys **Ctrl+H**.

The current execution stops.

To stop mission execution temporarily and then resume it, use the Pause command. If you click **Begin Simulation** after you have halted an execution, a new run is started.

**Setting the Execution Speed**

You can control the speed of real time mission simulation from the IMPRINT Pro tool bar. Execution speeds are 25%, 50%, 100%, 200%, 400%, and 800%; each execution speed is twice as fast as the speed listed above it.

**To set the execution speed:**

Do one of the following:
• From the **Execution** menu, click **Simulation Speed**.
• Click the **Simulation Speed** button on the tool bar.
Select the execution speed from the list that displays.

### Subchapter 5.5 Mission and Personnel Reports

Use the Reports menu to review one or more of the many reports in IMPRINT Pro pertaining to a model that you have just run.

**To view reports:**

1. Click the **Reports** menu.
   
   You will be presented with a submenu from which you can select the type of report (Operational Results, Maintenance Results, Personnel Attributes Reports and Cross Analysis Report) to be reviewed.

2. Click the report set you want to view.
   
   You will be presented with an additional interface displaying all available reports for the type you selected.

3. Check the report options you want, and then click **OK**.
   
   IMPRINT Pro creates a new Microsoft Excel workbook that contains a separate worksheet for each selected report and graph. A sample report workbook is shown in the following figure.

Each report can be accessed by clicking on its corresponding tab at the bottom of the workbook. You can obtain a printed copy of the report by selecting the Print icon located at the top of the screen in the tool bar.

**Note:**

Running and viewing reports following a model run requires that the user wishing to run and view those reports has the lock on the analysis containing that model. For any model which is unlocked or which is locked by another user on your network, reports will not be available after the model run. For more information on locking and unlocking analyses, see the *IMPRINT Pro User Guide Volume 1: Basic Procedures, Appendix D: Local Server and Remote Server Setup.*
Sample Mission Results Report
Operational Results Reports

Several reports are available after an Operations Model (Mission) has completed.

To display operational model reports:

1. From the Reports menu, click Operational Results.
   
   A dialog box displays showing all report options.

2. Check the reports you want to see, and then click the OK button.

3. If the Specialty Usage report is selected or if the Check All button is pressed, the Assign Grade Levels dialog displays, prompting you to select grade levels (E1-E9) for each of the Operators in your model.
4. For each listed operator, select a corresponding grade level from the drop-down list under the Grade column, and then click the OK button.

If the Workload Graph is checked, the Workload Over Time dialog box displays, prompting you for the range of time over which workload should be graphed.
Enter the desired **Start Time** and **End Time** for the range of data you wish to graph, and then click the **OK** button.

5. If the Operator Workload Detail report is checked, click the **Group** or **Ungroup** radio button to group or ungroup the data by simulation clock time.

6. Click **OK**.

   Excel launches, and all selected reports appear in an Excel workbook format. Select the report you want to view by clicking the corresponding tab at the bottom of the workbook.
Mission Performance

The Mission Performance report provides information on how the Achieved Mission Time, the performance time that was simulated in a run, compares with the Mission Time Requirement set by the user.

- **Times Performed.** Displays the number of times the mission was performed.

- **Standard.** Displays the Time Requirement you chose for the mission. The Time Requirement is the longest performance time that can be tolerated and have the mission still be considered a success. When IMPRINT Pro executes your mission model, the performance time that is predicted by aggregating your individual tasks will be compared to this standard to ensure that your design can meet the mission level time requirement.

- **Minimum, Maximum, Mean, and Std. Dev.** Displays the minimum, maximum, mean and standard deviation of the mission performance times across all runs.

- **% Met Time.** Displays the percentage of time the mission performance time meets the Mission Time Requirement.

- **% Met Accuracy.** Displays the percentage of time that the mission completed without aborting due to a task failure.
% Met Both Time and Accuracy. Displays the percentage of time in which both Mission Time Requirement and Accuracy are met simultaneously.

Results. The last column in this report shows the overall results of the mission simulation. If the proportion of times that the mission met the time and accuracy requirements meets or exceeds the total mission criterion that you set, then the message will say that the mission does meet the performance criterion. If the proportion is less than the mission criterion, then the message will say the mission does not meet the performance criterion.

### Mission Results by Run

The Mission Results by Run report displays mission performance times for all runs which took place during execution of a mission model. This report is helpful in locating a particular run of interest based on mission performance time. Since IMPRINT collects thousands of records for any model run, several of the reports in the Operations Results reports display data for only the first run. If you wish to view all task, function and workload data for a specific run in the rest of the reports, you must lookup the RNS
(random number seed) displayed in this report, set this number to the **Random Number Seed** box in the **Execution Settings** dialog, and then execute the model. The specific run will now become run 1, and all data will be available for that run. This technique allows modelers of simple and complex models to perform as many runs as necessary while not over taxing system memory and storage.

The Mission Performance by Run Report displays the following columns:

- **Run.** The run number.
- **Mission Performance Time.** The time it takes the mission to complete for the listed run.
- **RNS.** The random number seed used in the listed run. The random number seed is used to calculate task execution times and to cause other variability, such as taking different probabilistic paths, through the network. The random number seed is a number between approximately -2 billion and +2 billion (inclusive). The same seed always produces the same set of random numbers in the same order, and thus the same results.
- **Accuracy Results.** Displays whether or not there is a failure consequence. The failure consequence column might explain why some mission performance times for a run were cut short.
- **Histogram Data and Frequency.** Data for the Mission Results Histogram.

For more information see “Mission Results by Run Histogram” on page 307.
Chapter 5: Mission Analysis

Mission Results by Run Histogram

The Mission Results Histogram is a frequency distribution bar chart of the mission performance time for each run. The mission performance time data is divided into separate bins. Each bin is an equal time interval based upon the (maximum mission performance time - minimum mission performance time)/the number of bins. The number of bins is calculated via a commonly accepted algorithm for histograms. Each bin becomes a bar on the bar chart that shows the mission performance time distribution over all runs. This allows you to see, at a glance, if the mission performance times are distributed normally over the course of all the models runs.

✓ Note:
For less than 10 runs, the total number of bins displayed is one.
Function Performance

The Function Performance Report includes:

- **ID.** The ID of the listed function.
- **Function.** The name of the listed function.
- **Times Performed.** The number of times the listed function was performed over the course of all runs.

**Note:**
Any instance of a function in which the function starts and/or initializes but does not end will not be counted in the Times Performed total.

- **Standard.** Indicates the Function Performance Time Requirement. The Time Requirement is the longest performance time that can be tolerated and have the function still be considered a success. When IMPRINT Pro executes your mission model, the performance time that is predicted by the aggregation of all tasks in this function will be compared to this requirement to ensure that your design can meet the function level time requirement. If you did not enter a time requirement, it will default to zero (00:00:00.) Therefore, if you have already
entered nonzero task times in your functions but have not yet changed the time requirement, it will probably cause the percentage of time your functions meet this time requirement to be 0%.

- **Minimum, Maximum, Mean, and Std. Dev.** The minimum, maximum, mean, and standard deviation of the performance times. These fields will be blank for functions that did not execute, or in other words, for functions in which times performed is zero.

- **% Met.** The percentage of time for which the Function Performance Time Requirement is met.

---

### Function Performance Report

#### Task Performance

The Task Performance Report is a detailed report that provides performance data on all tasks in your mission model, including the tasks which did not fire during the model run. This report also includes a summary of the performance accuracy that was predicted for each task.

The following information displays for each task:

- **ID.** The ID number of the listed task.
- **Function.** The name of the listed task’s parent function.
- **Task.** The task name.
- **Operator.** The operator who performed the task.
- **Times Performed.** The total number of times this task was performed over all mission runs.

**Note:**
Any instance of a task in which the task starts and/or initializes but does not end will not be counted in the Times Performed total. For more information on the behavior of these tasks within the model run see “Workload Strategy Trace” on page 323.

**Time section of report:**
- **Standard.** The time requirement set for this task in the Time Requirement field. The time requirement is the longest performance time that can be tolerated and have the task still be considered a success.
- **Minimum, Maximum, Mean, Std. Dev.** The next four columns display the Minimum, Maximum, Mean and Standard Deviation of the task time. These are calculated from the simulation execution for all runs combined.
- **% Met.** The percentage of time that the task met the required time, or Standard.

**Accuracy section of report:**
- **Accuracy Standard.** The Accuracy Requirement for the task as set by the user.
- **Accuracy Measure.** The Accuracy measure (for example, “percent steps correct”).
- **% Met.** The percentage of time the task met the accuracy requirement.
- **Mission Aborts.** The percentage of time in which the task led to mission failure.

**Overall section of report:**
- **% Met Both Time and Accuracy.** The percentage of time in which both the Task Performance Time Requirement and Accuracy Requirement are met simultaneously.
Results. Displays whether or not the task met the Task and Accuracy Criterion. This Criterion is the minimum percentage of time a task must meet both the time requirement and the accuracy requirement simultaneously in order to be considered successful. IMPRINT Pro determines the % of time that the task meets both these requirements; if this number is equal to or greater than the number you set in the Criterion field in the task properties window, you will also see a message that says the task does meet the performance criterion. Otherwise you will see a message that the task does not meet the performance criterion.

Below is an example report where although the highlighted task met the Time Requirement (00:10:00.00) 47.4% of the time and the Accuracy Requirement of (25%) 48.7% of the time independently, the percentage of time in which the task met the required time and accuracy simultaneously (21.43%) fell short of the performance criterion (25%).
Task Sequence Chart

The Task Sequence Chart displays all task activity that occurred during a model run in the form of a Gantt chart. A timeline representing mission time displays along the bottom of the chart while tasks list along the right hand side of the chart. Instances of tasks are represented by colored bars at the same level as the listed task, the placement of which corresponds to the start time and end time of the task in the model run. A task’s duration at any one instance is represented by the length of the corresponding bar in the chart as measured against the timeline below.

For more information on Critical Path see “Mission Time Drivers” on page 313.

Task Failure

The Task Failure report provides a summary of all tasks that failed due to accuracy during mission execution and the consequences that occurred as a result, for each run. For any task, these failure consequences are defined in the Failure tab of that task. Use this report to verify that the consequences of failure for a task have been defined appropriately.

The Task Failure Summary provides the following information:

- **Run.** The number of the run containing the failed task.
- **Function Name.** The function containing the failed task.
- **Task Name.** Name of the task that failed.
- **Time.** The time at which the failure occurred.
Consequence of Failure. The consequence that was applied as a result of the task having failed. Possible consequences of the failed task include the following:

- The task is degraded in time.
- The task is degraded in accuracy.
- A new task (user-specified) immediately follows.
- The mission fails, and as a consequence, aborts.
- No effect on the mission.
- The operator and/or task assignment changes.
- The task repeats.

Mission Time Drivers

The Mission Drivers Summary identifies the tasks in the mission that make up the critical path through the network. The critical path is the necessary path or sequence from start to finish which determines the time needed for completion. It is also the longest most time-consuming path in the network thus leading to the mission performance time. Use it to identify a time flow impediment to the mission.
The report lists the following in temporal order (from time 0.000 seconds to mission completion):

- **ID.** The ID number of the listed task.
- **Function Name.** The function containing the task.
- **Task Name.** The name of the task that is on the critical path.
- **Beginning Time.** The time that the task started.
- **Ending Time.** The time that the task ended.
- **Performance Time.** Task ending time minus task beginning time, i.e. task duration.

**Note:**
The Mission Time Driver report omits all zero-time tasks along the critical path of the model. If you wish to view all tasks comprising the sequence of events your model run, including zero-time tasks, refer to the Workload Strategy Trace report.

---

**Mission Time Drivers Report**

**Mission Time Drivers Chart**

The Mission Time Drivers Chart displays only a subset of information contained by the Task Sequence Chart, specifically those tasks which contribute to the critical path of the mission.
All critical path task activity that occurred during a model run displays in the form of a Gantt chart. A timeline representing mission time displays along the bottom of the chart while tasks list along the right hand side of the chart. Instances of tasks are represented by colored bars at the same level as the listed task, the placement of which corresponds to the start time and end time of the task in the model run. A task’s duration at any one instance is represented by the length of the corresponding bar in the chart as measured against the timeline below.

For more information on Critical Path see “Mission Time Drivers” on page 313.

**Operator Workload Summary**

The Operator Workload Summary provides information about the total workload demand placed on an operator during the first run of a mission. To see the listings for a specific operator, scroll down the report until the data corresponding to the desired operator appears. The following information displays:

- **Clock.** The simulation clock time. Clock times are driven by any change in the model during the run, such as a task beginning or a task ending.

- **Operator.** The name of the operator incurring workload.

- **Threshold.** The operator’s workload threshold value as set on the operator’s properties dialog.

- **Sum of Data Over Time**

  - **Overall Workload.** The sum of all single task demand values and all conflict values (inter-channel and intra-channel) of all ongoing tasks that an operator is currently performing at a given instant in time.

  - **Single Task Demand.** The sum of all single task demands of all ongoing tasks that an operator is currently performing at a given instant in time. These demand values are set in the Workload Demand tab of the Task Properties window which is available by double-clicking a task in the Analysis Tree or in the Network Diagram.
**Total Conflict Value.** The sum of the total conflict values of all ongoing tasks that an operator is currently performing at a given instant in time. A channel conflict occurs when resource-interface pairs compete for the operator's attention. These values are defined in the Conflicts tab which is available by double-clicking the RI-Pairs node in the Analysis Tree. See examples below:

**Example 1:** Two simultaneous identical tasks both having a “fine motor/keyboard” resource-interface channel requirement would cause a channel conflict if, in fact, a conflict value were assigned to that combination. This is an example of Intra-channel conflict, a conflict which occurs when channel pairs use the same resource.

**Example 2:** Two simultaneous tasks both using the same “fine motor” resource but different interfaces, such as a keyboarding task (keyboard) and a writing task (pen). This is also an example of Intra-channel conflict, a conflict which occurs when channel pairs use the same resource.

**Example 3:** Two simultaneous tasks, one of which has a “fine motor/keyboard” channel requirement while the other has a “visual/computer screen” channel requirement, would potentially have a channel conflict if, in fact, a conflict value were assigned to that combination. This is an example of Inter-channel conflict, a conflict which occurs among channel pairs using different resources.

**Auditory, Cognitive, Fine Motor, Gross Motor, Speech, Tactile and Visual.** The sum of all single task demands on a particular resource at a given instant of time, considering all ongoing tasks. These sums are grouped by resource, both default resources and any user-added resources, and are reported by individual operator (scroll down the report to access similar data for subsequent operators.)
Chapter 5: Mission Analysis

Operator Workload Detail

The Operator Workload Detail report is similar to the Operator Workload Summary report in that it provides information about the total workload demand placed on an operator at certain points during the model run. In the Workload Detail report, however, for each clock time reported all ongoing tasks are listed separately. For each task, single-task demands for each interface pair also display.

- **Clock**. The simulation clock time. Clock times are driven by any change in the model during the run, such as a task beginning or a task ending.
- **Operator**. The operator assigned to the task.
- **Function Name**. The parent function of the task.
- **Task Name**. The task occurring at the reported clock time.
- **Sum of Data Over Time**: 
**Overall Workload.** The sum of all single task demand values and all conflict values (inter-channel and intra-channel) of all ongoing tasks that an operator is currently performing at a given instant in time.

**Single Task Demand.** The sum of all single task demands of all ongoing tasks that an operator is currently performing at a given instant in time. These demand values are set in the Workload Demand tab of the Task Properties window which is available by double-clicking a task in the Analysis Tree or in the Network Diagram.

**Total Conflict Value.** The sum of the total conflict values of all ongoing tasks that an operator is currently performing at a given instant in time. A channel conflict occurs when resource-interface pairs compete for the operator's attention. These values are defined in the Conflicts tab which is available by double-clicking the RI-Pairs node in the Analysis Tree. See examples below:

**Example 1:** Two simultaneous identical tasks both having a “fine motor/keyboard” resource-interface channel requirement would cause a channel conflict if, in fact, a conflict value were assigned to that combination. This is an example of Intra-channel conflict, a conflict which occurs when channel pairs use the same resource.

**Example 2:** Two simultaneous tasks both using the same “fine motor” resource but different interfaces, such as a keyboarding task (keyboard) and a writing task (pen). This is also an example of Intra-channel conflict, a conflict which occurs when channel pairs use the same resource.

**Example 3:** Two simultaneous tasks, one of which has a “fine motor/keyboard” channel requirement while the other has a “visual/computer screen” channel requirement, would potentially have a channel conflict if, in fact, a conflict value were assigned to that combination. This is an example of Inter-channel conflict, a conflict which occurs among channel pairs using different resources.
Auditory, Cognitive, Fine Motor, Gross Motor, Speech, Tactile and Visual. The sum of all single task demands on a particular resource at a given instant of time, considering all ongoing tasks. These sums are grouped by resource, both default resources and any user-added resources, and are reported by individual operator (scroll down the report to access similar data for subsequent operators.)

❖ Task Demands by Resource-Interface Pairs:

This section of the report shows the demands that any currently ongoing task is placing on each of the individual resource-interface pairs. By default, all analyses include the default interface “Crewstation.”

Grouped vs. Ungrouped

When selecting the Operator Workload Detail report in the reports selection dialog, you are presented with the option of choosing a Grouped or an Ungrouped version of the report:

❖ Grouped. For each instant of time reported in the Workload Detail report, the Sum of Data Over Time columns display their respective cumulative data values totaled over all tasks occurring at that given instant. For example, for a single time instant in which five tasks simultaneously occur, only one Overall Workload value will appear in a single cell adjacent to the five tasks, representing the total overall workload for all five of those tasks at that instant in time.

❖ Ungrouped. For each instant of time reported, the Sum of Data Over Time columns display the same respective cumulative workload data sums for all tasks occurring at that given instant as the Grouped report displays. These same values, however, are repeated next to each task listed, even though they represent the sum for all tasks together. In the event you wish to re-sort the data by task, these sum values will always accompany the task.
Channel Conflict

The Channel Conflict Summary shows you information about the conflict between any two resource-interface channels that an operator experiences over the course of a mission run. A conflict occurs when two or more tasks compete for that operator’s same resource. For example, an operator trying to listen to two radios at the same time, each of which are transmitting different messages, would cause a conflict in that operator’s auditory resource. If the interfaces of both were slightly different, for example a radio and a telephone, conflict would still occur in the auditory resource, but the channel conflict type would be of a different category.

The conflict values between channels are set in the Conflicts tab which is available by double-clicking the RI-Pairs node in the Analysis Tree. The following are examples of the two categories of channel conflict:

**Example 1:** Two simultaneous identical tasks both having a “fine motor/keyboard” resource-interface channel requirement would cause a channel conflict if, in fact, a conflict value were assigned to that combination. This is an example of **Intra-channel** conflict, a conflict which occurs when channel pairs use the same resource.
Example 2: Two simultaneous tasks both using the same “fine motor” resource but different interfaces, such as a keyboarding task (keyboard) and a writing task (pen). This is also an example of Intra-channel conflict, a conflict which occurs when channel pairs use the same resource.

Example 3: Two simultaneous tasks, one of which has a “fine motor/keyboard” channel requirement while the other has a “visual/computer screen” channel requirement, would potentially have a channel conflict if, in fact, a conflict value were assigned to that combination. This is an example of Inter-channel conflict, a conflict which occurs among channel pairs using different resources.

The report displays the following information for each operator:

- **Resource Interface Pairs 1 and 2.** The resource-interface pairs being analyzed for conflict. A resource-interface pair is a combination of any resource with any interface, for example the combination of “fine motor” and “keyboard.” These combinations are assigned in the Channels tab of the Resource-Interface Channels and Conflicts window, which is available by double-clicking the RI Pairs node in the Analysis Tree and selecting the Channels tab.

- **Conflict Value.** The conflict value assigned between any two resource-interface channel pairs. This value is assigned in the Conflicts tab of the Resource-Interface Channels and Conflicts window, which is available by double-clicking the RI Pairs node in the Analysis Tree and selecting the Conflicts tab.

- **Number of Times Assessed.** The number of times a conflict between any two resource-interface channel pairs is assessed. Conflicts are assessed each time there is a workload state change in the model and counted when any ongoing, non-zero time tasks at that time are experiencing channel conflict. For example if task A is running in the background while task B ends and task C starts in its place, task C might immediately have conflict with the ongoing task A at which point conflict between this pair is assessed as “1” and counted as “1”. If a second new task also having workload, task D, starts just shortly after task C, task D similarly contributes to a workload state change for the entire model in which case all channel conflicts for all pairs are once again assessed. The actual conflict between A and C remains the same, but the “Number of Times Assessed” for this pair now displays as “2”. These data are reported for the first mission run only.
Use this report to determine circumstances where an operator is repeatedly having conflicts between resources-interfaces channels. Conflicts are reported for the first run only.

Note:
For any operator whose conflicting tasks are reallocated to a contingency operator through workload strategy E or F, the resultant conflict for that primary operator for that instant of time is zero thus no records of conflict are reported for that instant.

---

**Workload Graph**

The Workload Graph displays each operator's total workload throughout the mission timeline for the first mission run. A unique Workload graph displays for each designated operator.

The workload is displayed as a step graph on an x-y axis. The x (horizontal) axis represents time and the y (vertical) axis represents the workload index. Each operator's workload profile is displayed in a different color. The key is located in the window.

The default time scale ranges from time 0.00 seconds through mission completion time and displays for the first run only.
Chapter 5: Mission Analysis

Workload Strategy Trace

The Workload Strategy Trace Report shows an ongoing history of model execution by listing each task as its status changes.

- **Clock Time.** The simulation clock time. Clock times are driven by any change in the model during the run, such as a task beginning or a task ending.

- **Operator.** The operator assigned to the task.

- **Function Name.** The parent function of the task.

- **Task Name.** The task experiencing a status change.

- **Strategy.** The workload strategy assigned to the operator performing the task. This strategy may consequently affect the Workload total and the Current Task Total depending on the strategy assigned in the Warfighter’s properties window.

- **Workload.** The amount of workload experienced by the operator assigned to the task, at the reported clock time.
**Task Status.** The state of the task as a result of a Release Condition, Beginning Effect, Ending Effect or any other factor within the task network affecting the operation of this task. Status values include the following:

*Initialize.* This task is the next task to be considered by the listed operator. If the Release Condition of this task evaluates as “True,” this task will start. If the Release Condition evaluates as “False,” the task never starts. An initialized task increases the Current Task Total number by 1. The ModelStart tasks is the only task whose Initialize condition does not display in the report.

*Started.* The task’s Release Condition is true, and the task is performed by the Operator. A Started task shares the same contribution to the Current Task Total for the same Operator as when it was an Initialized task.

*Ended.* The task has been performed to completion by the Operator. An Ended task decreases the previously-reported Current Task Total for the same Operator by 1.

*Resumed.* A previously suspended task is once again being picked up by the Operator. A Resumed task increases the previously-reported Current Task Total for the same Operator by 1.

*Restarted.* A previously stopped task is once again assumed by the listed Operator. A Restarted task increases the previously-reported Current Task Total for the same Operator by 1.

*Stopped.* The listed task terminates. A Stopped task decreases the previously-reported Current Task Total for the same Operator by 1.

*Suspended.* The task is currently put on hold until conditions are met such that it may resume. A suspended task decreases the previously-reported Current Task Total for the same Operator by 1.

*Not Started.* The operator’s assigned strategy is applied in the release condition of a task, and as a result the task does not start.

**Current Task Total.** The total number of tasks currently assigned to the Operator, including the named task except in the case when the Task Status is Ended.
Snapshots

The Snapshot Report allows you view the values of variables and the method by which they are triggered. Snapshots are defined in the Snapshot Properties window, which is available by double-clicking a listed snapshot under the Snapshots node in the Analysis Tree.
Stressor Settings

You can apply five different stressors (cold, heat, noise, MOPP, and sleepless hours) to tasks in the Settings option of the Moderators menu. The Stressor Settings report allows you to view all the stressors you set for the model. The report will display the following information:

- **Function Name.** The parent function of the task.
- **Task Name.** The task that the stressor has been applied.
- **Warfighter.** The name of the operator who will perform the task.
- **Specialty.** A three-character designation representing the operator's specialty.
- **Stressor.** The type of stressor.
- **Level.** The level at which the stressor has been applied.
Goal Status Report

The Goal Status report shows the status of the mission and all goals within it every time the status of the mission or any goal changes during the model run. For each clock time listed, the status of the mission lists first, followed by the status of all goals in order of goal priority (highest priority goals listed at the top.)

- **Run.** The number corresponding to the model run.
- **Clock.** The simulation clock time at which a status change occurred in the model, either in the mission or in a goal.
- **Mission or Goal.** The mission or goal whose status is being reported.
- **Status.** The current state of the listed goal or mission.

The Goal Status report displays the following possible status changes:

- **Not started.** The listed goal has not yet started (goals only).
- **Running.** The listed goal or mission is currently running.
Interrupted. The listed goal or mission has been interrupted by another goal. Only goals having a higher priority can interrupt other goals in the mission. All goals are able to interrupt the mission.

Ended Normally. The listed goal or mission completes.

Aborted. The listed goal is aborted (terminated) by another goal in the mission. A goal can abort only lower-priority goals. Goals cannot, however, abort the mission.

Specialty Utilization Report - Operations Model

For users who regularly use the Army Military-Civilian Cost System (AMCOS) to estimate the cost of using a fixed number of military personnel for a specific number of years, the Specialty Utilization Report is designed to provide you information about the utilization of all the specialties in your model run which may then be used as a basis for the data you enter into AMCOS.
In general, AMCOS requires that you enter specialty, the number of people of each specialty, and all years of service to be included in your cost estimate so that it can give you an estimation on how much it costs to support these specialties for those years. After having run an IMPRINT Pro model, you may use the Specialty Utilization Report to gain a better understanding on the types and quantities of personnel you need based on your model run results.

The Operations Specialty Usage report includes the following data:

- **Specialty Rank.** The specialty and rank which categorize the operator whose usage is being reported.

- **# of Specialty.** The number of operators in the model of the specialty and rank specified who contributed to the total usage time.

- **Time.** The cumulative amount of time all operators having the designated specialty and rank spent performing tasks in the model, for example, the cumulative amount of time that all 19K E4 operators spent time on tasks in the

Before entering data into AMCOS based on this report, the idea of “utilization” according to IMPRINT Pro must be understood. In the Operations model, utilization is considered to be the total time an operator spends actually working on tasks and is not the amount of time an operator is simply available. These two concepts differ in the case of suspended tasks where an operator is present but no actual work is being done on that
task by an operator. If the operator, however, is pulled onto a different task while the first task is suspended, the amount of time that operator works on the second task is added to the total utilization amount reported by the Specialty Utilization Report. In short, the utilization is a sum of all time the operator spent performing any task within the network. More detailed information about the individual tasks performed by an operator can be found in the Workload Strategy Report, the report on which the Specialty Utilization Report is based.

It is also important to note that the utilization reported by the Specialty Utilization Report is for the total duration of the model; if the total clock time of your model run is any less than one year, the utilization hours reported will not correlate directly with the expected values AMCOS requires, which are specifically the full years that you need a specialty. You must project out from the utilization summary the number of people of a certain specialty you need and the number of years your specialty must be available; this interpolation of the data may require more expertise beyond what the Specialty Utilization Projection Report can provide. The quantities of each specialty and the years for which they are required could vary depending on how many people of each specialty your mission requires and how many similar missions you intend to execute within the course of a year.

AMCOS requires users to enter data in four steps: Properties, Faces and Spaces, Cost Summaries and Output. The part of AMCOS to which your IMPRINT model run results apply is the Faces and Spaces step where you add information about the personnel required. This part of AMCOS is depicted in the image below:

The Faces and Spaces page contains the following fields:

- PayPlan
The only fields where IMPRINT report data applies are in the **Group**, **Subgroup**, **Grade** and **Inventory** fields.

**Applying IMPRINT Pro report data to AMCOS**

*To apply IMPRINT Pro report data to AMCOS:*

1. Select the desired group from the drop-down list.

![Dropdown list](image)

**Note:**
In IMPRINT Pro, all specialties from which you may select your Warfighters are grouped together in one list. In AMCOS, however, specialties are categorized into different groups. The first two characters in a specialty code defines the group to which that specialty belongs.

The selected group appears in the **Group** field, and the **SubGroup** drop-down list is enabled.
2. From the **SubGroup** drop-down menu, select the desired subgroup (specialty).

The selected subgroup appears in the **SubGroup** field.

3. From the **Grade** drop-down menu, select the pay grade which applies to the selected Group-SubGroup combination.
In the IMPRINT Pro Operations model, Operators do not, by default, have an E-level assigned to them. In the process of generating the IMPRINT Pro reports, however, you will first be prompted to select an E-level for each operator. Once the values are selected, they appear in the Operator Specialty Usage Report, the report on which you can then base your AM COS data. The selected grade appears in the Grade field.

4. The Inventory section displays a box for each year you are choosing to project costs. In each box provided, enter the number of personnel for which costs are to be projected.
5. Click the **Insert** button in the lower-left corner of the screen.

The specialty data you entered is added to the list at the top of your AMCOS screen. You may repeat these steps for all specialties to be included in your cost projection. Once you have finished entering specialty information, you are finished with the portion of AMCOS which requires data from IMPRINT. Proceed with the remaining steps in AMCOS as normal.

---

**Graph Data**

The Graph Data Report displays all data use to generate the Workload graphs. The Graph Data report contains duplicate rows of data which are added for graphing purposes. These extra rows allow the data to be shown as a "step chart," an enhancement than enables the report to show workload over time.

The graph data included in this report shows all operators in one dataset. Only one graph will be generated from this data.
Personnel Forecast Report

For every operator in your analysis having a unique specialty, the Personnel Forecast Report displays the number of people of that specialty who will be available over the course of the next five years. Estimates are broken down by E-level (E3, E4...E9).

To create a Personnel Forecast Report:

1. From the Reports menu, click Personnel Forecast.

   The Personnel Forecast report dialog box displays.

2. In the Personnel Forecast report dialog, check the boxes corresponding to the data you wish to view. Available options are:
• **Personnel Forecast**: this report displays forecast data for all unique specialties in your list of operators in a single report. For every year forecasted, the report breaks down the number of forecasted personnel for that specialty by E-level (E3, E4...E9). Data are presented in a tabular format.

• **Personnel Forecast Graphs**: for each unique specialty in your list of Operators, a new graph report is created, displaying that specialty’s forecast data in the form of a three-dimensional bar chart. For every year forecasted, the report breaks down the number of forecasted personnel for that specialty by E-level (E3, E4...E9).

3. Click **OK**.

Microsoft Excel launches, and the reports display.

In the example below, the report is run for five different helicopter repairman specialties: 15M, 15R, 15S, 15T and 15U. The generated report displays estimates on how many personnel of each specialty category will be available through the year 2012.

---

**Note:**

In the example below, IMPRINT Pro omits the 15M specialty due to the unavailability of data for this specialty.
The Personnel graphs display the same information in the form of a bar chart.

Personnel Forecast Report
Cross Analysis Report

The Cross Analysis Report allows you to display the results of one or more missions (or scenarios) side-by-side and compare their summary data.

To run the Cross Analysis Report:

1. Run the missions in your models that you wish to compare.

2. From the Reports menu, select Cross Analysis Report.

   A report selection dialog appears.
3. If you wish to compare Mission runs, click the **Operations Model** radio button.

   A list of all missions run in the current session of IMPRINT Pro appear.

4. Check the box for each mission you wish to include in your comparison.

5. Click **OK**.

   Excel launches, and the Cross Analysis report appears.

   ![Cross Analysis Report](image)

   Summary data for all selected missions displays.

6. Follow comparison of equipment scenarios, click the **Maintenance Model** radio button.
7. Check the box for each scenario you wish to include in your comparison.

8. Click **OK**.

Excel launches, and the Cross Analysis report appears.
### Chapter 5: Mission Analysis

#### IMPRINT Maintenance Model Report

#### Cross Analysis Comparison

<table>
<thead>
<tr>
<th>Analysis Name:</th>
<th>Scout Helicopter</th>
<th>Self-propelled Howitzer</th>
<th>Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis Version:</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>DNS:</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Scenario:</td>
<td>Ten Days of Missions</td>
<td>Ten Days of Missions</td>
<td>Ten Days of Missions</td>
</tr>
<tr>
<td>ScenarioID:</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Maintenance Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Operating Hours</td>
<td>4 8000</td>
</tr>
<tr>
<td>Average Preventive Maintenance Hours</td>
<td>0 000</td>
</tr>
<tr>
<td>Average Corrective Maintenance Hours</td>
<td>2 800</td>
</tr>
<tr>
<td>Average Maintenance Per Operating Hour</td>
<td>0 740</td>
</tr>
</tbody>
</table>

#### Reliability Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments Requested</td>
<td>1</td>
</tr>
<tr>
<td>Segments Accomplished</td>
<td>1</td>
</tr>
<tr>
<td>Number of Times Systems Requested</td>
<td>4</td>
</tr>
<tr>
<td>Number of Times Systems Requested Accomplished</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Availability Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Inherent Availability</td>
<td>97.54</td>
</tr>
<tr>
<td>Average Achieved Availability</td>
<td>97.54</td>
</tr>
<tr>
<td>Readiness</td>
<td>100.00</td>
</tr>
</tbody>
</table>

#### Combat Damage

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Segments</td>
<td>1</td>
</tr>
<tr>
<td>Total Number of Operation Hours</td>
<td>4 0000</td>
</tr>
<tr>
<td>Number of Combat Hits</td>
<td>0</td>
</tr>
<tr>
<td>Combat Damage Repair Time (hours)</td>
<td>0 0000</td>
</tr>
</tbody>
</table>

#### Logistic Summary (Hours)

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5 - On Wait for Spare Parts</td>
<td>0 0000</td>
</tr>
<tr>
<td>D5 - Off Wait for Spare Parts</td>
<td>0 0000</td>
</tr>
<tr>
<td>D6 - On Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>D6 - Off Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>Contact Team Wait for Spare Parts</td>
<td>0 0000</td>
</tr>
<tr>
<td>Crew Chief Wait for Spare Parts</td>
<td>0 0000</td>
</tr>
<tr>
<td>Org Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>DG - On Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>DG - Off Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>D5 Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>Contact Team Wait for Maintenance</td>
<td>0 0000</td>
</tr>
<tr>
<td>Crew Chief Wait for Maintenance</td>
<td>0 0000</td>
</tr>
</tbody>
</table>

Summary data for all selected scenarios displays.
Chapter 6: Equipment Analysis

This chapter describes the IMPRINT Pro Equipment analysis capability. The chapter is divided into subchapters that describe how to enter the data needed to describe the system equipment, the properties for operational scenarios, settings that control mission execution methods used to analyze the results data, and how to create charts displaying the values of variables during execution.

The objective of the Equipment module is to help you estimate maintenance manhour requirements for your system. This module lets you enter properties that control such items as the maintenance manpower pools, the spare availability, and the combat damage potential. These properties, coupled with a mission schedule and the data describing the maintenance actions that your system may need are combined in a stochastic maintenance simulation. The primary purpose of the simulation is to predict the maintenance manhours required to attain an acceptable system availability.

Introduction to Equipment Analysis

To conduct an IMPRINT Pro analysis of the maintenance manhour requirements to support a particular system, follow these steps:

1. Divide the system into separately maintained components. For each component described, provide the following information:
   • How often the component needs to be maintained (such as rounds fired, time operated)
   • The type of repair task that needs to be performed (remove & replace, repair, inspect, troubleshoot, and so on.)
   • Whether the maintenance is preventive or corrective
   • The maintenance organizational type at which the task needs to be performed (for example, ORG, DS, GS)
   • The type and number of maintainers that are needed to perform the repair task
   • How long it will take to perform each repair task
   • Probability of mission abort
   • Whether a contact team could perform the maintenance
• Adjust estimated task times and accuracies by setting PTS levels.

This information will be contained in the IMPRINT Pro Repair Task dialog box with a column for each of the maintenance properties listed above for each Repair Task. The data will be used as input to the IMPRINT Pro maintenance simulation model.

If you are using IMPRINT Pro to evaluate the maintenance requirements for a proposed new system in the acquisition cycle, you can enter the component maintenance properties from scratch or from a system design. However, it is more likely that you will begin by copying maintenance properties from a similar library system and then modifying existing components and/or adding new components to reflect the system you are trying to evaluate.

If you are using IMPRINT Pro for a different purpose, such as unit design, you may want to simply copy a library system and use it as is, using the same components and maintenance actions and modifying only the types of maintainers, maintenance levels, or other properties for the existing components.

2. Build a simulation scenario that will define the conditions under which the system you are modeling will be used and the amount of usage the components in each system will incur. Scenario segments will determine subsystem usages and probabilities for combat damage. Each scenario can contain multiple segments.

3. Define the unit configuration and support properties for each scenario. These properties include:

   • **Maintenance shift manning (size, type)**. This parameter defaults to the minimum possible shift manning, as well as one shift per day that is eight hours long. IMPRINT Pro calculates the minimum shift manning by examining each repair task to find the minimum number of people in each specialty that will enable any given task to be performed.

   • **Spare parts (availability, wait times)**. This is also an optional parameter and is specified at the subsystem level. This parameter defaults to 100% availability, and a zero wait time.
Subchapter 6.1 Equipment Data

Equipment data consists of several items:

- **Subsystems.** Subsystems are typically something like an engine, landing gear, or main gun.

- **Components.** Components are subsets of subsystems. Components are the individual pieces of equipment that have repair tasks attached. You can enter or edit maintenance data for all repair tasks associated with the components.

- **Repair Tasks.** Repair tasks are attached to individual pieces of component equipment.

**Subsystems**

An equipment analysis consists of several subsystems. Subsystems are typically items like an engine, landing gear, or main gun.

**Displaying Subsystems**

*To display a subsystem:*

Double-click the Subsystems node.

This action will display a list of all the major subsystems for the system that you are modeling in the main window.
Subsystems information includes the following:

- **Subsystem**: The first column will display a list of all subsystems you have added to your equipment analysis. A major subsystem is typically something like an engine, landing gear, or main gun.

- **Equipment Group Name**: The second column contains the Equipment Group name or equipment type. There are three possible equipment types, Armaments, Mobility, and Other.

The equipment type of each subsystem determines how the usage will be accrued to each component in the subsystem and the basis on which each component will require maintenance.

- **Mobility** subsystems will accrue usage and require maintenance based on the distance travelled by the system.

- **Armaments** subsystems will accrue usage and require maintenance based on rounds fired from that subsystem.

- **Other** subsystems accrue usage and require maintenance based on the time the system is operated.

- **Date Last Modified**: The third column shows the date you last made changes to your Equipment analysis.
Adding Subsystems

To add a subsystem:

1. In the Analysis Tree, right-click the Subsystems node.

2. Select Add Subsystem from the menu that displays.

Note:

IMPRINT Pro will name your new subsystem Subsystem. If you continue to add subsystems, each following subsystem will be named SubsystemX where X is the next integer. You can edit the name of the subsystem in the Name field in the Subsystems dialog box.

Copying Subsystems

To copy a subsystem:

1. In the Analysis Tree, right-click the subsystem (for example, Subsystem1) below the Subsystem node.

2. Select Copy Subsystem from the menu that displays.

Cutting Subsystems

To cut a subsystem:

1. In the Analysis Tree, right-click the subsystem below the Subsystem node.

2. Select Cutting Subsystem from the menu that displays.

When you paste the subsystem to another Equipment mission, IMPRINT Pro will remove the subsystem from its current location to the new location.

When you click in the Analysis Tree, the subsystem will be highlighted in red and remain in its position until you paste it to a new position. Once you perform a Paste command, the subsystem will be removed from its old position.
Pasting Subsystems

To paste a subsystem:

1. Copy or cut a subsystem.

2. Right-click the Subsystem node in the equipment model that you want to add the subsystem to.

3. Select Paste Subsystem from the menu that displays.

Deleting Subsystems

To delete a subsystem:

1. In the Analysis Tree, right-click the subsystem (for example, Subsystem1) below the Subsystem node.

2. Select Delete Subsystem from the menu that displays.

Components

Subsystems are decomposed into components. Components are the individual pieces of equipment that have repair tasks attached. You can enter or edit maintenance data for all repair tasks associated with the components.

Displaying Components

To display the list of components for the subsystem:

1. In the Analysis Tree, click the + adjacent to the Subsystem node.

   A Components node will display under the subsystem.

2. Double-click the Components node.

   A list of components displays below the Component node in the Analysis Tree and in the main window.
Adding Components

To add a component:

1. In the Analysis Tree, right-click the Components node.
2. Select Add Component from the menu that displays.

IMPRINT Pro adds a component to the Analysis Tree below the Components node and to the list of components on the Components Information dialog box in the main window.

Note:
IMPRINT Pro names the new component Component. If you continue to add Components, each following component will be named Component and is numbered, increasing by one for each addition. You can edit the name of the component in the Components Properties Window name box.

Deleting Components

To delete a component:

1. In the Analysis Tree, right-click the component (for example, Component1) below the Components node.
2. Select Delete Component from the menu that displays.

Cutting Components

To cut a component:

1. In the Analysis Tree, right-click the component child node (for example, Component1) below the Components node.
2. Select Cut Component from the menu that displays.

When you click in the Analysis Tree, the component is highlighted in red. When you paste the component to another Equipment scenario, IMPRINT Pro will remove the component from its current location to the new location.
Copying Components

*To copy a component:*

1. In the Analysis Tree, right-click the component (for example, Component1) below the Component node.
2. Select **Copy Component** from the menu that displays.

Pasting Components

*To paste a component:*

1. Copy or cut a component.
2. Right-click the Components node in the Equipment analysis that you want to add the component to.
3. Select **Paste Component** from the menu that displays.

Displaying Component Information

*To display component information:*

Double-click the component child node (for example, Component1) to see a Component information screen in the main window.

The Subsystem Name and Equipment Group Name display on the component information screen.
Repair Tasks

You can attach Repair Tasks to individual pieces of component equipment. Repair tasks require maintainers which affect your maintenance manpower estimates. There are 33 different repair task types available for selection. Examples include Adjust and Repair, Inspect, Remove and Replace, Test and Check, and Troubleshoot.

Displaying Repair Task Lists

To display repair tasks for each component:

1. In the Analysis Tree, click the + beside component child node (for example, engine, fuel pump, or Component1).

   The Repair Tasks node will display below the component node.

2. Click the + adjacent to Repair Tasks node.

   A list of repair tasks will display below the Repair Tasks node in the Analysis Tree.

Adding Repair Tasks

Below the Repair Tasks node IMPRINT Pro allows you to add repair tasks. You can add each of these repair tasks twice.

To add a repair task:

1. In the Analysis Tree, right-click the Repair Tasks node.
2. Select **Add Repair Task** from the menu that displays.

One of the following repair tasks or Maintenance Actions will be added below the Repair Tasks node:

- Access
- Adjust
- Adjust & Repair
- Align
- Calibrate
- Camouflage
- Clean
- Debug
- Disassemble/Assemble
- Dispose
- Evaluate
- Fault Location
- Inspect
- Install
- Load/Unload
- Lubricate
- Mission Profile Change
- Monitor
- Operate
- Overhaul
- Package/Unpackage
- Preserve
- Process
- Rebuild
- Remove
- Remove & Replace
- Repair
- Service
- Set Up
- Test & Check
- Transport
- Transport Preparation
• Troubleshoot

✔ Note:
The Remove and Replace repair task is the only task type for which a wait time for spare parts (entered in the Spares tab of the scenario) can accrue. This total time accrued appears in the Logical Summary report.

Displaying Repair Task Data

IMPRINT Pro compiles all of the repair tasks and the associated data for each component in a worksheet. You can display the worksheet and make changes to the repair tasks.

To display repair task data in the main window:

Double-click the Repair Tasks node.

Repair Task data displays in the main window.

The Subsystem and Component names for the repair task will display in the boxes at the top of the window.

Displaying Repair Task Properties

Each component could require several possible maintenance actions or types of repair. Each individual action is associated with a set of maintenance properties.
To display repair task properties:

In the Analysis Tree, double-click the repair task (for example, Adjust and Repair) below the Repair Tasks node.

The Properties dialog box for the repair task will open in the main window. You can review or edit the repair task as required.

The Subsystem and Component that the repair task is attached to displays at the top of the dialog box.

- **Action.** You can assign maintenance actions for each component by clicking the arrow to the right of the Repair Task box and selecting one of the five maintenance actions in the drop-down list. These five maintenance actions include: Adjust & Repair, Inspect, Remove & Replace, Test & Check, and Troubleshoot.

- **Maintenance Type.** Click the arrow to the right of the Maintenance Type box to select one of the two types of maintenance actions:
  - Preventive. Preventive maintenance is scheduled at fixed intervals.
Corrective. Corrective maintenance is required when a component fails because of usage or combat damage.

Organizational Level. This is an indication of the maintenance level that will perform the maintenance action. Click the box to the right of the Organizational Level box to select one of the three possible maintenance levels:

Organizational (ORG). Typically, this is referred to as the first level of maintenance. It usually is associated with maintenance that is performed at the unit level. ORG level maintenance is always performed “On Equipment.” That is, the system is unavailable for missions until the maintenance is complete.

Direct Support (DS). Second level of maintenance. DS maintenance can either be performed “On Equipment” or “Off Equipment.” On equipment maintenance makes the system unavailable during the time that maintenance is being performed. An example of an on equipment task is changing a tire or a filter. Off equipment maintenance are repairs that are performed once a part has been removed from the system. The system itself remains available for missions. An example of an off equipment task is fixing a hole in a tire after you have already replaced the tire with a spare. All Org level maintenance is assumed to be performed “On Equipment.” All GS level maintenance is assumed to be performed “Off Equipment.”

General Support (GS). Third level of maintenance. GS level maintenance is always performed “Off Equipment.” This means that the system can return to the mission while the component is being repaired. Most often, this is relevant for “remove and replace” maintenance actions. After IMPRINT Pro has determined that a spare is available, the system will be fitted with the spare component and will return to “available” status. Meanwhile, any outstanding repair actions for that system will be performed on the component that has been removed.

Specialty and Skill Level. This is the first military occupational Specialty and skill level that are required to perform the maintenance. IMPRINT Pro accepts two Specialties so there are two Specialty and Skill Level fields. You can click the arrow to the right of the Specialty box to select another Specialty.

Number of Specialty. This contains the number of maintainers of each Specialty that are required to perform the maintenance. Click in the box to edit.
Means Operational Units Between Failure (MOUBF). This is the number of operational units between failure, or more accurately stated the number of operational units between the need for this maintenance action. Depending on the “Type” for this subsystem the units could be rounds fired, distance traveled, or the amount of time that the system has been operating. The actual time that this action will occur in the simulation will be drawn from a negative exponential distribution embedded in IMPRINT Pro with a mean equal to the MOUBF you enter. Unlike the Mean Time To Repair, however, the distribution type and standard deviation of this value is not editable.

Mean Time To Repair (MTTR). This value represents the average time it takes to perform this maintenance action. This value and the standard deviation for the repair time (MTTR Standard Deviation) and the Distribution type are used to generate a simulated time for this maintenance action.

% Abort. This value represents the percentage of time that the need for this maintenance action will cause the entire system to abort the current segment and require that the maintenance action be done immediately. In the case of a repeating segment, segments will resume on schedule once the required maintenance action is complete. If the abort % is set to 0%, the segment is not aborted and continues even if the repair task comes up; the required maintenance, however is done once the segment is over. If the scenario run ends before the repair task can begin, the repair task will never occur since it is outside the window of the scenario run. If the abort % is set to 100%, in all cases any time this repair task comes up the segment is immediately aborted and maintenance begins. For all values in between, the need to abort a segment is based on the probability of the value entered.

If a repair task’s % Abort value is set to 100% but there is no ongoing segment at the time the repair task kicks in, then there is no segment to abort in the first place. Therefore it is possible to have repair tasks (having abort %100) occur within a scenario of repeating segments and for that task to not affect the total operating hours. If a segment in a repeating series is aborted by a repair task, the series resumes when the next scheduled segment is set to occur.

Contact Team (CT). This cell indicates (True/False) if this maintenance action can be performed by a contact team. If the contact team is enabled (flag set to “True”) then the maintenance action is routed to the contact teams as long as the following parameters are met: 1) the number of maintenance tasks waiting
in the queue is less than the total number of tasks all the contact teams combined are capable of handling, and 2) the number of maintainers needed to perform the maintenance is less than the number of maintainers on the contact team.

❖ Crew Chief (CC). This cell indicates (True/False) if the repair task can be routed to the Crew Chief. When a repair task is flagged for the Crew Chief (flag set to "True"), the repair will go to the Crew Chief if the repair task is needed, provided the spare part is available. If the spare part is not available, the system repair is instead routed to the task’s default maintenance organization and is delayed for the time needed to procure the spare part. Sending a repair task to the Crew Chief also requires that at least one operator in the Warfighters Operators list be a designated Crew Maintainer; any operator designated as such must have its Crew Maintainer check box in its properties window checked. If no operator is a designated crew maintainer, a message appears upon starting a simulation run that the model contains no crew maintainers, and the model is temporarily suspended. By clicking “Ok” to this message, the model resumes its run, but all maintenance repair actions flagged for the crew chief are instead routed to the default maintenance org level.

### Copying Repair Tasks

**To copy a repair task:**

1. In the Analysis Tree, right-click the repair task (for example, Adjust and Repair) below the Repair Task node.
2. Select **Copy Repair Task** from the menu that displays.

### Cutting Repair Tasks

**To cut a repair task:**

1. In the Analysis Tree, right-click the repair task you want to cut.
2. Select **Cut Repair Task** from the menu that displays.

When you click in the Analysis Tree, the repair task is highlighted in red. When you paste the repair task to another component or model, IMPRINT Pro removes the repair task from its current location and places it in to the new location.
Pasting Repair Tasks

To paste a repair task:

1. Copy or cut the desired repair task.

2. Right-click the Repair Tasks node that you want to paste your task to.

3. Select **Paste Repair Task** from the menu that displays.

   The pasted task displays below the Repair Task node.

---

**Note:**

If you paste a repair task having a Maintenance Action and Maintenance Type identical to an existing Repair Task under the same node, the Select Maintenance Action dialog box will appear, prompting you to choose a new Maintenance Type and/or Action for this task from the list of remaining available combinations.

---

Selecting Maintenance Actions

To select a maintenance action:

1. Select the Maintenance Action and Maintenance Type combination that best fits the repair action you want to model.
Chapter 6: Equipment Analysis

2. Click OK.

The repair action will be pasted to the Repair Tasks node in the Component.

Deleting Repair Tasks

To delete a repair task:

1. In the Analysis Tree, right-click the repair task (for example, Adjust and Repair) below the Repair Tasks node.

2. Select Delete Repair Task from the menu that displays.

Importing Maintenance Task Data from a Template

As an alternative to adding subsystems, components and repair tasks one item at a time through the Analysis Tree, you can enter all maintenance data into an Excel template which can later be imported into IMPRINT Pro in a single action. The template required to do this, importIMPRINTPRO.xlt, is included in the IMPRINT Pro directory on your machine.

Adding Data to the Maintenance Template

To add data to the maintenance template:

1. Navigate to the IMPRINT Pro root directory on your system. If you chose to install IMPRINT Pro using the default settings, the root directory is C:\Program Files\IMPRINTPro.

2. Locate the file called importIMPRINTPRO.xlt. This file is the IMPRINT Pro Maintenance Template.
3. Double-click the file.

Microsoft Excel launches, and the IMPRINT Pro Maintenance Template opens.

The Maintenance Template contains fields for entering subsystem, component or repair task data. Each row corresponds to a separate repair task, each of which must be unique.

4. Enter the desired maintenance data in the template. All required fields are highlighted in red.
Once you have finished entering data into the template, you are ready to export your data.

**Exporting data from the Maintenance Template**

**To export data from the Maintenance Template:**

1. From within the Maintenance Template, click the **Create Data Import File** button located at the top of the template.

   The **Save Copy As** dialog appears.

2. From the **Save in** field at the top of the window, browse to the location to which you wish to export your maintenance template data for import into Pro.
3. Enter a new name in the **Filename** field or use the default name provided.

   The default name is unique to the date and time the template is exported.

4. Click the **Save** button.

   The exported template data saves to the selected location and name.

---

### Importing Maintenance Template data into IMPRINT Pro

You can use the **Import Maintenance Data** option in IMPRINT Pro to import maintenance data you have exported from the IMPRINT Pro Maintenance Template.

**Note:**

The option to import maintenance data into an analysis is available only to the user having the lock on the analysis. For more information on locking and unlocking analyses see *IMPRINT Pro User Guide Volume 1 - Basic Procedures, Chapter 1: Basic Procedures, Understanding the Analysis Environment, Locking and Unlocking Analyses.*

---

**To import maintenance template data into IMPRINT Pro:**

1. Launch IMPRINT Pro.

2. Create or load the analysis into which you wish to import your maintenance template data.

3. From the **File** menu, select **Import Maintenance Data**...

4. From the **Import Maintenance Data**... submenu, select **Import from Spreadsheet**.

   A dialog immediately prompts you to save your changes in the current analysis. Click **Yes** if you wish to save your model prior to import. Otherwise click **No**.
5. In the Open dialog which appears, browse to the location of your data file exported from the maintenance template. The file you select must have the extension “.maintPRO.”

6. Select the file, and then click the **Open** button.

A message displays, indicating the status of the imported data.

7. View the imported maintenance data in the Analysis Tree under the **Equipment** node for the model you have selected.
Map Maintenance Tasks to Taxons

IMPRINT Pro automatically maps taxon weights to the repair tasks in a maintenance scenario. The **Maintenance Task Taxon Mappings** dialog allows you to modify the mapping of taxons and taxon values for maintenance tasks. You can return to the default values set by IMPRINT Pro by clicking on the Reload Defaults button at the bottom of the dialog.

Modifying the taxons is only one part of using them. Taxons work in conjunction with stressors assigned to repair task types to impact calculated repair task times.

Example: In the Maintenance Task Taxon Mappings dialog, shown below, the repair task called “Adjust and Repair” involves some fine motor discrete action. On the stressor by taxon table, Table 2 on page 521, you can see that the stressor “COLD” affects the task time of a task involving a fine motor discrete action. Applying this stressor will impact the repair task time because of the nature of the task.
To map maintenance tasks to taxons:

1. Click Map Maintenance Tasks to Taxons below the Moderators menu.

The Map Maintenance Tasks to Taxons dialog displays.

2. Do one or more of the following:
   - Adjust taxons by clicking the drop down arrow to the right of the Taxon box, and then select a taxon from the list that displays.
   - Adjust taxon weight by clicking in the Taxon Weight box, and then type a new value.
   - Return to default values by clicking the Reload Defaults button.

Note:
To see the impact of taxons on the task times, you need to remember to set stressors on the “Stressors” dialog in the Moderators menu, and check the PTS Adjustments box in the Executions Settings menu before you run the model.
Subchapter 6.2 Scenarios

You can develop many scenario data sets for each system. For example, you might want to create one scenario for a thirty-day run and another scenario that contains input parameters for a ten-day run. When you have selected a scenario, this option also lets you add mission segment data for that scenario.

This interface contains the list of scenarios available for your maintenance model. To view more information about a scenario, double-click it. This will let you edit and review the scenario properties.

Displaying Scenarios

To display scenarios:

Double-click the Scenario node below the Equipment node in the Analysis Tree.

A list of Scenarios will display in the main window.
Adding Scenarios

To add a scenario:

1. In the Analysis Tree, right-click the Scenario node.
2. Select Add Scenario from the menu that displays.

   A new scenario is added to the list below the Scenario node on the Analysis Tree and to the list in the main window.

Note:

IMPRINT Pro names the new scenario Scenario. If you continue to add Scenarios, the new scenario will be named Scenario1 and each following scenario is numbered, increasing by one for each addition. You can edit the name of the scenario in the Scenario Properties Window name box.

Displaying Scenario Data

To display scenario data:

   Double-click the scenario (for example, Scenario1) below Scenario node in the Analysis Tree.

   A tabbed dialog box will display in the main window including Segments, Fuel Supply, Ammo Supply, Travel Times, Spares, Maintenance Crew, and Contact Team.

Segments Tab

Select the Segment tab to view the list of segment missions that have been added to the Scenario.
Fuel Supply Tab

Select the Fuel Supply tab to view the fuel supply properties.

To calculate the number of trips required by the transporter during your scenario run, check the **Use Fuel Supply** box, and then enter the following information:

- **Transporter Name**. The transporter name.
- **Capacity (gallons)**. The fuel capacity of the transporter, in gallons.
\begin{itemize}
\item **Load Time per Trip.** The amount of time required to load the fuel into the transporter.
\item **Maximum number of daily trips.** The maximum number of trips the transporter can make in a single day. This number affects the number of warfighters and transporters required by your scenario; a greater number of trips a transporter can make in a day means less overall transporters required.
\item **Specialty 1 and 2.** The type of specialty required to man the transporter. Select the desired specialty by clicking the drop-down arrow adjacent to the **Specialty** box and selecting from the list provided. If the one you desire is not listed, you must return to the Warfighters node to add it under the Supply and Support Personnel node. Once added, the new specialty displays in the combo box and may then be selected. For each specialty you choose, enter the skill level and quantity required in the **Level** and **Number** fields.
\end{itemize}

IMPRINT Pro will use this information to calculate the number of transporters and the associated manpower required to supply the necessary fuel for your scenario. After executing the maintenance model for this scenario, the supply results will be presented in the Supply and Support Results report.

**Ammo Supply Tab**

Select the Ammo Supply tab to display the Ammo supply information.

\begin{table}[h!]
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Transporter Name & Weapon System & Capacity (fl rounds) & Load Time \\
\hline
Transporter & Ammunition & 2000 & \\
\hline
\end{tabular}
\end{table}

Ammo Supply properties include a scenario name at the top of the dialog box and a description of the scenario. Other properties include:

\begin{itemize}
\item **Transporter Name.** The Transporter Name.
\end{itemize}
- **Weapon System.** The subsystem to which the transporter belongs. This subsystem must be of type “Armament”.

- **Capacity (# rounds).** The number of rounds of ammunition.

- **Load Time Per Trip (hours).** The amount of time required to load the transporter with ammunition, in hours.

- **Specialty 1 and 2.** The type of specialty required to man the transporter. To select the desired specialty, start by clicking the Specialty cell; a drop-down arrow appears. Click the drop-down arrow, and select a specialty from the list provided. If the one you desire is not listed, you must return to the Warfighters node to add it under the Supply and Support Personnel node. Once added, the new specialty displays in the combo box and may then be selected. For each specialty you choose, enter the quantity required in the Number fields.

- **Max # Daily Trips.** The maximum number of trips the transporter can make in a single day. This number affects the number of warfighters and transporters required by your scenario; a greater number of trips a transporter can make in a day means less overall transporters required.

Use the **Add** and **Delete** buttons to add or delete transporters from the list. You may add one transporter for each subsystem of type “Armament” in your list of subsystems.

### Travel Time Tab

Select the Travel Time tab to enter the average number of hours it takes to travel from the location of system breakdown to the selected maintenance facilities. These maintenance facilities will be labeled as Org, DS and GS unless you edit the organizational level names.
Travel time properties include:

- **Travel Time.** The travel time you enter, in hours, represents round trip travel. This time is added to the maintenance time for a system to accurately reflect system availability. It does not affect maintenance manhours. It only affects the total time to repair the system.

Enter the travel times to move the system to and between the different maintenance levels. These travel delay times will be used to predict how long it will take to transport the system, or the component, to the appropriate organizational level. Note that in the maintenance analysis, for any system requiring multiple repairs at multiple levels, all first level (ORG) maintenance is performed first, then second level (DS), and then third level (GS). The travel time is a one-time assessment for each system each time it completes a mission segment and needs maintenance. To change travel times, click in the box and enter time.

- **Contact Team.** You can also enter the amount of time for a Contact Team to reach the system which needs to be repaired.

### Spares Tab

Select the Spares tab to specify (by subsystem) the percent of time a spare part will be available when needed for a repair action and, if not available, the delay time until it will be available.
Spares properties include:

- **% Available.** This optional capability lets you enter the probability a spare part is available if needed for maintenance. You can enter a different probability for each subsystem in the IMPRINT Pro repair task worksheet.

- **Wait in Hours.** The time a system must wait (in hours) for a spare part to become available if needed.

Spare availability only affects Remove and Replace tasks being performed at the first (for example, Unit, Org, or AVUM) level of maintenance.

**Note:**
In order for the Crew Chief to be able to work on a particular subsystem, % Available must be set to 100% for that subsystem. Spares affect only the Repair and Replace tasks at the 1st level (ORG) which are the only tasks that the Crew Chief would be able to perform.

**Maintenance Crew Tab**

Select the Maintenance Crew tab to define the shift manning for each specialty performing tasks at each maintenance level type [for example, Organizational (Org), Direct Support (DS), General Support (GS)]. You can also identify shift manning for more than one shift. If you have edited the names of the different maintenance levels, your new labels will replace the ones shown.
To set the shift manning, you use a worksheet that contains the number of people within each specialty for each maintenance shift that can work in parallel throughout your scenario. When you click one of the maintenance organizational type buttons (Org, DS, or GS), IMPRINT Pro displays the worksheet for that level.

The Scenario name will display at the top of the Maintenance Crew worksheet. Maintenance Crew Properties include the following:

- **Shift Length.** The numbers of hours in a shift.

- **Shifts per day.** The number of shifts of this length in a 24-hour period; shift length is constrained such that the shift length X shifts per day cannot exceed 24 hours.

- **Performed at level.** The maintenance shift level whose data you are entering. Click the drop down arrow to select an organizational level (Org, DS, or GS). To edit the maintenance organizational level names, see “Editing Maintenance Org Levels” on page 387.

- **Specialty.** This column includes all of the specialties that are marked as maintainers under the Warfighters section of IMPRINT Pro. For details on choosing the maintainer role for a Warfighters, see “Displaying Maintainers” on page 78.

- **Skill Level.** This is the skill level for the Specialty. Skill levels include 10, 20, 30, 40, or 50.
Minimum. Identifies the minimum number you can enter for manning of each Specialty at each organizational level. This minimum is calculated by examining your repair tasks to find the maximum number of people in a given Specialty needed on a single repair task. This ensures that your crew will be able to perform every task that could occur.

Maintenance Shift number. There is one column for each of the shifts per day.

Click in a cell of the worksheet to edit the contents of the cell. Select an entire row or column by clicking the row number or column name.

By default, when you run a maintenance model in IMPRINT Pro, the Execution Settings window is automatically set to run the model in an unconstrained mode. This means that IMPRINT Pro will initially ignore the shift manning in this worksheet, and that at any time a maintainer is needed to perform a maintenance action, that maintainer is assumed available and an unlimited number of repair tasks can be performed in parallel. To activate these optional crew constraints from this shift manning worksheet when running your scenario, however, you must first check the Crew Limits On option in the Execution Settings Maintenance Model dialog box prior to running your model.

To evaluate which Specialties are the most heavily utilized, we recommend you refer to the Headcount Histogram Report. This is discussed in detail under “Reports” in IMPRINT Pro User Guide, Vol. 1 IMPRINT Pro Basic Procedures.

Contact Team Tab

Select the Contact Team tab to define properties that determine how IMPRINT Pro will model contact teams.
Chapter 6: Equipment Analysis

Contact Team properties are:

- **Number of Contact Teams.** The number of contact teams available for the entire scenario.
- **Number of maintainers in each Contact Team.** The number of multi-functional maintainers in each contact team.
- **Maximum number of repair actions that can be waiting for Contact Team attention at one per Team.** The maximum number of repair actions that can be waiting for Contact Team attention at once per team. If this number is exceeded, maintenance actions are then routed to the selected maintenance levels (Org, DS and GS).

The general rule in the IMPRINT Pro maintenance model is that when enabled, the contact team will perform all possible maintenance actions until the maximum number of repair actions in the queue is exceeded.

### Copying Scenarios

Copy a scenario to add a new scenario that has a data set exactly like the scenario. You should give the replicated scenario a name that is different than the original scenario.

**To copy a scenario:**

1. In the Analysis Tree, right-click the scenario below the Scenario node.
2. Select **Copy Scenario** from the menu that displays.
Cutting Scenarios

To cut a scenario:

1. In the Analysis Tree, right-click the scenario below the Scenario node.

2. Select Cut Scenario from the menu that displays.

   The scenario is highlighted in red. When you paste the scenario to another Equipment mission, IMPRINT Pro will remove the scenario from its current location to the new location.

Pasting Scenarios

To paste a scenario:

1. Copy or cut the scenario you want to paste.

2. Right-click the Scenario node in the Equipment mission that you want to paste to.

3. Select Paste Scenario from the menu that displays.

Deleting Scenarios

To delete a scenario:

1. In the Analysis Tree, right-click the scenario (for example, Scenario1 or Ten Days of Missions) below the Scenario node.

2. Select Delete Scenario from the menu that displays.

   IMPRINT Pro will delete the Scenario from the Analysis Tree and the list in the main window. It will also delete all information associated with that scenario, such as segment data.

Segments

Each scenario is composed of a set of mission segments. These segments can be thought of as missions, in which a number of your systems are exercised. During a segment, the components accrue usage, which can lead to component failure.
You can define several segments for each scenario. For example, if you are modeling a large number of systems, you may want to define different segments for smaller subsets of your total number of systems.

**Displaying Segments**

*To display a segment mission:*

1. In the Analysis Tree, double-click a scenario child node (for example, Scenario1).

   A Segment node displays below the Scenario child node on the Analysis Tree, and the Scenario Data dialog box displays in the main window with the Segment tab selected.

2. Double-click the Segment node.

   A list of Segment missions appear below the Segment node and in the main window.

---

**Note:**
Do not confuse these missions with the operational missions described in Chapter 5: “Mission Analysis.” While they are similar concepts, none of the data you entered under Mission will affect the results of your Equipment analysis.
Adding Segments

To add a segment:

1. In the Analysis Tree, right-click the Segment node.

2. Select Add Segment from the menu that displays.

Note: 
IMPRINT Pro names the new segment Segment1. If you continue to add segments, each following segment will be named SegmentX where X is the next integer. You can edit the name of the segment in the Name field in the Segment Properties dialog box.

Displaying Segment Data

To display segment data:

Double-click the segment name (for example, Segment1).

A dialog box displays in the main window including tabbed windows: Segment Info, Consumables, and Combat Damage.
Segment Info

Select the Segment Info tab to display segment information in the main window. Segment properties include:

- **Segment Start Time and Segment Start Day.** These boxes work together to identify the start time of this segment. These values default to 0.0 and 1. If you were to leave the default values in both of these boxes, this mission would begin at time 0 on day 1.

- **Cancellation Time.** If the minimum number of systems required for the segment cannot be met by the Segment Start Time, the simulation will wait until the Cancellation Time (the amount of time beyond the Segment Start Time) to check once more for the minimum number of systems. If the minimum number of systems
is available at this Cancellation Time, the segment will proceed. If the minimum number of systems is not met by the Cancellation Time, the segment is cancelled. In the case of a repeating segment, once the cancellation time is past the segments will once again attempt to resume at the next scheduled time interval.

- **Segment Priority.** When more than one segment has been defined to occur at the same time, the segments must compete for available systems. In this box, you can enter a priority number for each segment. The segment with the higher priority value will get available systems first. If several segments have the same priority number, the first one on the list will be filled first. A priority of 1 is higher than a priority of 5.

- **Use Mission for Duration Time.** Check this box to use the duration of an operational mission model run as your segment Duration Time.

- **Duration Time.** This value indicates the number of operational hours a system is out on a mission (the proposed elapsed time between its departure and its return, provided no combat damage is sustained while it is out.) Additionally, this time is used to determine usage for the equipment on which failures are triggered by time. If using a time from an operational mission model run as your Duration Time, check the Use Mission for Duration Time check box, and then select the desired mission from the drop-down list.

- **Number per Departure Group.** This value controls the number of systems that are sent out in each group. A group can also be referred to as a “frag”.

- **Time Between Departures in minutes.** This value is the time between departure groups.

- **Repeating.** A Repeating segment, indicated by a check in this box, is one in which IMPRINT Pro’s maintenance model will attempt to restart the same segment after a specified amount of time. You can identify the frequency of the segment (for example, “repeats every eight hours”) using the Repeat Mean Time and Standard Deviation fields (see explanations below.)

- **Repeat Mean Time.** The Mean Time represents the average number of hours past the Segment Start time at which the segment will attempt to restart. This value applies only if the Repeating check box is checked.
- **Standard Deviation.** Enter a Standard Deviation to add variability to your Repeat Mean Time. To calculate a standard deviation, simply compute the difference between the worst and best performance and divide it by 6. This value applies only if the Repeating check box is checked.

- **Minimum Number of Systems.** This value is the minimum number of systems that must be available for deployment in order for the segment to proceed. If the minimum number of systems is met at the segment start time, the system groups depart as scheduled. If the minimum number is not met by the segment start time, the simulation will wait until the segment cancellation time, at which time it will then check for system availability once more. If the minimum number of systems is still not met by the cancellation time, all departure groups in this segment are then cancelled. Although this number determines the minimum number of systems required for a segment, it should be noted that the number of systems actually made available to your entire scenario run is controlled by the value entered in the **Number of Systems** field in the **Maintenance tab** of the **Execution Settings** window.

- **Maximum Number of Systems.** This value is the maximum number of systems that would be assigned to your segment if available. Although this number determines the maximum number of systems required for a segment, it should be noted that the number of systems actually made available to your entire scenario run is controlled by the value entered in the **Number of Systems** field in the **Maintenance tab** of the **Execution Settings** window.
In the sample segment pictured above, the simulation must wait until 10:00am (Segment Start Time) to start the segment. At this time, the simulation checks for a minimum of five available aircraft (Minimum number of systems) in order that the segment may proceed. If these aircraft are not available, at 10:00am, the simulation will wait until one hour later, i.e., 11:00am (Cancellation Time) to recheck for the minimum number of aircraft. If five aircraft are not available by this time, the segment is cancelled, and no aircraft depart.

The segment is scheduled to release two aircraft (Number per Dept. Group) every 0.6 hours, i.e. 10 minutes (Time between departures.) We would therefore expect our aircraft groups to leave at 10:00am, 10:10am and 10:20am. If only 5 aircraft are available for the segment, the last aircraft departs by itself at
10:20am. Each aircraft sent out is predicted to be out for a total of four hours (Duration Time), round trip. If two aircraft leave every 10 minutes starting at 10:00am, we would expect the aircraft groups to return approximately four hours later at 2:00pm, 2:10pm, and 2:20pm, provided no combat damage is sustained. If the Time between departures was left at 0 hours, there would be no set delay between groups thus all 5 aircraft (or 6 if 6 are available) would depart at the same time (10:00am) and return at the same time (2:00pm).

The segment is set to repeat every eight hours (Repeat Mean Time). In this example, the simulation will once again restart the process of sending out aircraft at 18, 26 and 34 hours for n days of simulation into the model run, provided the minimum number of systems is available.

**Combat Damage**

To view and modify the combat damage properties for this segment, click the Combat Damage tab in the Mission Data dialog box.

Combat properties will display in the main window.

Contact Damage properties include the following:

- **% of Combat Hit.** The hourly probability that a system will sustain a combat hit.

- **% of Attrition.** Given a combat hit, the probability that the system is a total loss.
- **System Replacement Time.** If the system is killed, the number of hours before the system can be replaced.

- **System Repair Time if damaged.** If the system can be repaired, the amount of time needed to complete the repairs.

The repair time will impact system availability; however it is not included in the maintenance manhour requirements reports. This is because IMPRINT Pro doesn’t know which component(s) need repair due to combat damage, and therefore, doesn’t know which Specialty would be needed. Consequently, all time spent performing combat damage repair is reported in the Combat Damage report, and is not attributed to any particular Specialty.

**Consumables**

Click the Consumables tab to view and modify Consumables data.
For each of the subsystems, there is an assigned Equipment Group Name of Armament, Mobility, or Other. For each Armament subsystem, you need to specify the number of rounds of ammunition that will be fired from the weapon that contains that subsystem during this segment.

Consumable properties include:

- **Distance per hour per segment.** You can enter the distance your system will travel during each hour of the segment, which is needed before the segment begins.

- **Load Time per segment.** You can enter any load time required for this segment. Load time refers to the time needed to repair the system to perform the segment. The load time will not require maintenance manhours, but could affect system availability.
**System Fuel Usage (gallons/distance unit)**. You can also enter the amount of fuel used by the system in gallons per distance unit. This value is used to help IMPRINT Pro calculate the Supply and Support requirements of each scenario.

The distance traveled and rounds fired are used to accrue usage to the components of systems as they perform the segments. Ultimately, this will cause components to fail, based on the Mean Operational Units Between Failure (MOUBF) of each component.

**Copying Segments**

*To copy a segment:*

1. In the Analysis Tree, right-click the segment you want to copy.

2. Select **Copy Segment** from the menu that displays.

**Cutting Segments**

*To cut a segment:*

1. In the Analysis Tree, right-click the segment you want to delete below the Segment node.

2. Select **Cut Segment** from the menu that displays.

   The segment is highlighted in red. When you paste the segment to another Equipment mission, IMPRINT Pro will remove the segment from its current location to the new location.

**Pasting Segments**

*To paste a segment:*

1. Copy or cut the segment you want to paste.

2. Right-click the Segment node in the Equipment mission that you want to paste to.

3. Select **Paste Segment** from the menu that displays.
Deleting Segments

*To delete a segment:*

Select the segment and do one of the following:

- Select **Delete Segment** from the menu that displays.
- Click the **Delete** button.

The segment is deleted.

Editing Maintenance Org Levels

This option allows you to change the names of the maintenance organizational levels. You are limited to 10 characters. Once you edit these levels, the new names will show up on all interfaces and reports that refer to the maintenance organizational levels.

*To edit org levels:*

1. From the **Edit** menu, select **Preferences**.

   The Preference dialog box displays with tabs: Specialty, Time, Temperature, Shapes and Colors, and Maintenance Org Levels.

2. Select the **Maintenance Org Levels** tab.

   The Org Levels dialog box displays.

   ![Preferences dialog box](image)

   Click inside the Org Level boxes to type your changes.

3. To save the Org Level changes, click **OK**.
4. To cancel the Org Level changes, click **Cancel**.

**Subchapter 6.3 Running the Equipment Scenario**

Once you have created an equipment model with subsystem and scenario parameters defined, you are ready to run the scenario. Several settings control scenario execution which are available through the Execution Settings window.

**Displaying the Execution Settings**

The option to access the Execution Settings window is found underneath the Execution menu. All settings for the Maintenance model are available through the Maintenance tab of this window.

In a Maintenance model, the settings control length of the run, the random number seed, and the number of systems. You will have the option to collect PTS Adjustments data, and can check the Crew Limits On check box allowing IMPRINT Pro to ignore the shift manning on the Maintenance Crew dialog box.

**To display execution settings:**

From the main menu, select **Execution**, and then select **Settings**.

The Execution Settings window displays. If you already have a scenario currently selected, then the Execution Settings window, by default, displays the Maintenance Model settings.

**Maintenance Scenario Execution Properties**

The following is a detailed description of the execution properties for a Maintenance scenario.

- **Length of Run.** You may select the time period over which to execute your model. The default time period is one day.
Random Number Seed. You can set the number used to generate random numbers for calculating task execution times and taking probabilistic paths through the network. The random number seed is a number between approximately -2 billion and +2 billion (inclusive). The same seed always produces the same set of random numbers in the same order, and thus the same results.

Number of Systems. You can select the number of systems to run. In Segments, you specify the minimum number of systems required for a segment. In Execution Settings, you can quickly change the number of actual systems you have available for use at the time you want to run the model. The number of systems defaults to one.

PTS Adjustments. You may choose to run the maintenance model with or without adjustments. If you check PTS Adjustments, any applications of stressors, training frequency, or personnel characteristics will be used to modify Mean Time to Repair (MTTR) data for each task. If you do not check PTS Adjustments, the maintenance model will be run with the original (or baseline) MTTR data.

Crew Limits On. You can check this box to run the scenario in a constrained mode, using the maintenance crew constraints you entered in the Maintenance Crew dialog box. If you do not check this box, IMPRINT Pro will run in an unconstrained mode, and will ignore the shift manning on the Maintenance Crew worksheet.

Executing the Maintenance Model

To execute the maintenance model:

1. Select a Maintenance scenario in the Analysis Tree.

2. From the Execution menu, select Settings.

   The Settings dialog box displays.

3. If not already selected, click the Maintenance Model tab at the top of the Settings dialog box.

   IMPRINT Pro loads the data for the currently-selected maintenance model and displays the scenario name in the top of the dialog box.
4. If a different scenario is desired, use the drop-down list box at the top of the dialog box to select the scenario you want to execute.

5. Adjust the remainder of the execution settings as desired.

6. To begin execution of the model do one of the following:
   • From the Execution menu, select **Begin Simulation**.
   • Click the **Begin Simulation** button on the tool bar.

Execution options allow you to start, resume, pause, or halt scenario execution; step through scenario execution one event at a time; and change the speed of execution. For more information, see “Subchapter 5.4 Running the Mission” on page 279.

**Viewing Scenario Model Data During Execution**

IMPRINT Pro uses several different windows to display model data during execution. Some windows show the values of systems in use and cumulative repair hours while others display logic errors, such as an array index out of bounds or division by zero. IMPRINT Pro also includes built-in tools to quickly locate, debug and correct any errors in the model.

- **Animator Window**. The Animator Window displays scenario data during an operations model run.

- **Output Tab**. The Output window displays messages about actions which occur during a model run. Any syntax errors are indicated and may be useful for debugging your model.
Search and Replace Tab. The Search window lets you search the entire model or selected components for a string of text. You may also optionally replace any found text with a new string of text you provide.

Animator Window

The Animator Window displays Warfighter data during an operations model run. This data includes the following:

- **Queue Data.** The number of systems waiting for maintenance and the cumulative amount of time spent waiting by one or more systems displays for each Org level.

- **Maintenance Summary.** The Maintenance Summary section displays the total number of preventive and corrective maintenance manhours across all org levels.

- **Combat Data.** The Combat Data section describes the total number of systems sent out on missions, the number of systems which have sustained damage and require repair and the number of systems lost.

- **Reliability and Availability.** This section describes the number of systems and segments which were requested accomplished.

- **Shift Manned.** The Shift Manned section displays a check mark to indicate whether the current clock time falls in one of the shifts or not. For example, two shifts lasting eight hours apiece will occur from clock time 0.00 hours to 8.00 hours and 8.00 hours to 16.00 hours. Any point during the model which takes place from 16.00 hours to 24.00 hours occurs during the non-manned shift thus the check mark appears next to “No”.

- **Mode.** The Mode section displays a check mark to indicate whether or not the Crew Limits On option is checked in the Execution Settings window. If this option is selected, the number of maintainers available is constrained to the numbers entered in the shift manning columns of the Maintenance Crew tab for the chosen scenario.

- **Clock.** The current clock time in the simulation run.

- **Day.** The current day in the simulation run.
❖ **Percent Time Elapsed.** The Percent Time Elapsed value is the amount of simulation clock time which has elapsed relative to the total run time of the model (length of run in days.)

**Output Tab**

The Output window displays the actions that just finished happening in a running mission. These actions, known as Trace Data, display as follows:

❖ Clock values for beginning effects
❖ Clock values for ending effects
❖ Clock values for external events
❖ Syntax errors
❖ Whether or not the plugins are successfully loaded when IMPRINT Pro is started
❖ Application errors

When a run begins and completes, the following messages will display:

❖ **Simulation Complete.** An indication that the model run was successful and that reports are available for viewing.

❖ **Duration.** The time required to process all model runs since the last time the Begin Simulation button was pressed.

❖ **Clock.** The amount of time the model ran within the context of the mission or scenario. For example, if you run a scenario for 3.00 days in the Execution Settings window, the Clock time reported would be 72.00 hours

**Displaying Trace Data**

To display trace data in the Output window:

1. From the View menu, click Windows, and then click Output from the menu that displays.

2. Under the Utilities menu, click the Display Trace option to enable it (a check mark next to the option ensures it is enabled.)
3. From the **Execution** menu, click **Begin Simulation**.

As the scenario runs the trace data displays in the Output window.

✓ **Note:**
If the Display Trace option is disabled during the model run, the Output window will report minimal information about the model run.

---

**Saving Trace Data Output to File**

You can save the results in the Output window to a file, save the results to the Windows clipboard, and clear the data in the window.

**To save Output to file:**

1. Right-click the Output window.

2. Select **Save Output to File** from the menu that displays.

   The Save As dialog box displays.

3. Select the destination of the folder from the **Save in** box.
4. Type a file name in **File name** box.

5. Click **Save**.

   The contents of the Output window save to a file on your system.

**Copying Trace Data Output to Clipboard**

*To copy output to Windows clipboard:*

1. Right-click the Output window.

2. Select **Copy Output to Clipboard** from the menu that displays.

   The contents of the Output window automatically copy to the Windows clipboard. You can then paste the data to an external application.

**Copying Selected Trace Data Output**

This option can be used to save specific sections of the Output window as desired.

*To copy selected output:*

1. Select the trace date you want to copy by highlighting it in the Output window.
2. Right-click the Output window.

3. Click **Copy Select Output** from the menu that displays.

   The data copies to the Windows clipboard. You can then paste the data to an external application.

**Clearing the Output Window**

With each consecutive model run, IMPRINT Pro clears the results from all previous model runs in the Output window. You may, however, clear the results in the Output window at any time independent of running the model.

**To clear the Output window:**

Do one of the following:

- Right-click the Output window and click **Clear Output** from the menu that displays.
- From the **Edit** menu click **Clear Output**.
- Press the shortcut keys **Ctrl+Shift+L**.

The Output window clears.

**Search and Replace Tab**

The Search provides the option for locating strings of text in the model. You may either search the entire model or select components only. The components you can search depend on the type of model that is checked in the Execution Settings window. Components available for search in the Maintenance model are:

- Everything (all components)
- Warfighters
- Subsystems
- Components
- Repair Tasks
- Scenarios
- User Stressors
Displaying the Search window

To display the Search window:

Do one of the following:

• From the View menu, select Windows, and then click Search from the menu that displays.
• Select the Search tab at the bottom of the Output window.

The Search window displays.

Searching in a Maintenance Model

If you are running a Maintenance model, the Search window for the Maintenance model displays.
Searching for Text

To search for text:

1. In the Find What box of the Search window, type the text string you want to find.

   By default, the search feature is not case-sensitive. Check the Match Case box if you want to find a string with the same capitalization (for example, Time is different than time).

   Space characters are allowed in the string.

2. In the Look In section, select the model elements to search by clicking the adjacent box(s).

3. Click the Find button.

   IMPRINT Pro searches for the text string and displays each occurrence of that string in the field on the right side of the Search window.

   You can stop the search at any time by clicking the Stop Search button.

4. Click ✗ to close the Search dialog box.
Checking for Syntax Errors

IMPRINT Pro allows you to check your model for syntax errors using the Check for Errors option located in the Execution menu and the tool bar. The Syntax Checker scans the entire model and immediately reports any errors in the Output window.

To check for syntax errors:

1. From the View menu, select Windows, then click Output.

   The Output window displays.

2. Do one of the following:
   • From the Execution menu, click Check for Errors.
   • Click the Check for Errors button on the tool bar.

   Any errors that are detected display in the Output window.

3. To open the dialog box where the error occurs, double-click the error.

   Due to the fact that the maintenance model is a stochastic model, errors encountered through the syntax checker have the potential to occur far less frequently than in the operations model. However, any issues that do arise will appear in the Output window. IMPRINT Pro generally indicates the nature of the problem in the error message, for example, displaying the message “unrecognized word” for a misspelled or undeclared variable.

   For more information on common syntax errors and possible solutions, see IMPRINT Pro User’s Manual Volume 3, Appendix: Checking for Errors.

Controlling Execution

IMPRINT Pro provides commands to start, stop, pause, resume, and step through execution of a model. You can also set the speed for mission execution.
Starting and Resuming Scenario Execution

To start or resume scenario execution:

Do one of the following:

- From the **Execution** menu, click **Begin Simulation**.
- Click the **Begin Simulation** button on the tool bar.
- Press the shortcut keys **Ctrl+G**.

The mission executes or resumes execution.

✓ Note:
Before executing the scenario, check the execution preferences to make sure the model is set to run as desired.

Pausing Scenario Execution

You can temporarily pause scenario execution. When scenario execution is paused, you can make changes to the model attributes such as the values of variables.

To pause scenario execution:

1. To pause scenario execution do on of the following:
   - From the **Execution** menu, click **Pause Simulation**.
   - Click the **Pause** button on the tool bar.
   - Press the shortcut keys **Ctrl+P**.

   The scenario pauses executing.

2. When you are ready to resume scenario execution, click **Begin Simulation** from the **Execution** menu.

Stepping Through Scenario Execution

You can step through mission execution one event at a time. This method of execution is useful for debugging a mission. This command is available only when the mission has not yet begun execution or when mission execution is paused.

To step through scenario execution:

1. Do one of the following:
• From the **Execution** menu, click **Step Simulation**.
• Click the **Step Simulation** button on the tool bar.
• Press the shortcut keys **Ctrl+T**.

**IMPRINT** Pro executes the next event and pauses.

2. Select **Step Simulation** again.

**IMPRINT** Pro executes the next event and pauses.

3. To resume continuous execution, click **Begin Simulation** from the **Execution** menu.

### Stopping Scenario Execution

You can stop the current execution of a scenario at any point. When you halt scenario execution, *it cannot be resumed*. The run is terminated and must start over.

**To stop scenario execution:**

Do one of the following:

- From the **Execution** menu, click **Halt Simulation**.
- Click the **Halt Simulation** button on the tool bar.
- Press the shortcut keys **Ctrl+H**.

The current execution stops.

To stop scenario execution temporarily and then resume it, use the Pause command. If you click **Begin Simulation** after you have halted an execution, a new run is started.

### Setting the Execution Speed

You can control the speed of real time scenario simulation from the **IMPRINT** Pro tool bar. Execution speeds are 25%, 50%, 100%, 200%, 400%, and 800%; each execution speed is twice as fast as the speed listed above it.

**To set the execution speed:**

Do one of the following:

- From the **Execution** menu, click **Simulation Speed**.
• Click the **Simulation Speed** button on the tool bar.

Select the execution speed from the list that displays.
Subchapter 6.4 Analyzing Equipment Results

When you run a scenario, IMPRINT Pro produces reports containing data from the scenario run based on parameters that you set up in the Execution Settings dialog box. These reports include trace, task, and snapshot data in the form of a workbook and can be viewed using Microsoft Excel.

Note:
Running and viewing reports following a model run requires that the user wishing to run and view those reports has the lock on the analysis containing that model. For any model which is unlocked or which is locked by another user on your network, reports will not be available after the model run. For more information on locking and unlocking analyses, see the IMPRINT Pro User Guide Volume 1: Basic Procedures, Appendix D: Local Server and Remote Server Setup.

Maintenance Model Results Reports

To create maintenance model reports:

1. From the Reports menu, select Maintenance Results.

   When you make this menu selection, a new dialog box will display prompting you to check the reports you want to generate for that scenario.

   ![Maintenance Model Reports Dialog Box]

   2. Select each report you want to view by clicking its check box to the left.

   3. Click OK to generate the reports.
3. Click **OK**.

IMPRINT Pro uses Microsoft Excel to generate and display the selected Scenario reports.

**Sample Maintenance Model Results Report**

Each of the individual reports are presented as separate tabs at the bottom of the Excel Workbook. To navigate between reports, click the labeled tabs. For more information on using Microsoft Excel, please refer to the Microsoft Excel help feature.

**Maintenance Summary Report**

The Maintenance Summary report contains four data items that summarize the maintenance actions that were generated during the simulation:

- **Total Operating Hours** (simulated).
- **Average Preventive Maintenance Hours**. Calculated by taking the total amount of manhours in this category, and dividing it by the total number of systems in the scenario.
- **Average Corrective Maintenance Hours**. Calculated by taking the total amount of manhours in this category, and dividing it by the total number of systems in the scenario.
Average Maintenance Per Operating Hour. The average maintenance manhours simulated per operational hour, calculated by dividing the sum of the preventive and corrective maintenance manhours by the total operating hours for all systems.

Daily Maintenance Report

The Daily Maintenance report contains the amount of maintenance manhours that were simulated at all organizational level types (for example, ORG, DS, GS) for both preventative maintenance and corrective maintenance.

The values in this report are totals across all systems.
Reliability and Availability Report

The Reliability and Availability report has two parts:

- **Reliability Summary.** The Reliability Summary includes measures for the number of **Segments Requested** and the number of **Segments Accomplished** during the simulation. An “accomplished” segment is one whose minimum required number of systems was met at the start of the segment, i.e., the request for the segment could be fulfilled; it does not necessarily mean that the segment completed.

  The report also includes measures for the number of times systems were requested and the number of times that those system requests were accomplished. The **Systems Requested** number will always reflect the maximum number of systems value you enter for a segment. This is because this number represents the ideal number of systems to send out in the segment; the segment may still proceed, however, if the minimum number of systems you set for the segment is met. The **Systems Accomplished** number, however, will reflect the number of systems which were actually assigned to accomplished segments. In other words, if a segment requires a minimum of two systems and a maximum of four systems, the segment will be accomplished if 2, 3 or 4 systems are available; the number of systems accomplished in this case will be the number that go out on the segment (2, 3 or 4), provided the
minimum (2) is met. If only one system is available at the time of request, the segment’s minimum cannot be met thus the segment does occur. Since the segment does not occur and no systems go out, the number of systems accomplished goes to zero.

- **Availability Summary.** The Availability Summary includes the following calculated values:

  **Average inherent availability** = \((\text{scenario length in hours} \times \# \text{ of systems}) \text{ minus (total clock hours on corrective maintenance)}) \text{ divided by (scenario length in hours} \times \# \text{ of systems)}\)

  **Average achieved availability** = \((\text{scenario length in hours} \times \# \text{ of systems}) \text{ minus (total clock hours on corrective + preventive maintenance)}) \text{ divided by (scenario length in hours} \times \# \text{ of systems)}\)

- **Note:**
  Inherent and achieved availability consider the total number of days simulated in hours (for example, \(365 \times 24\)), minus the number of clock hours spent in maintenance. Therefore, if two or more Soldiers are working at the same time on the same system, they are counted just once. Similarly, if two maintenance tasks are being worked on at the same time, it is only counted once.

- **Readiness** = \(\frac{\text{segments accomplished}}{\text{segments requested}}\)

This report includes all segments that completed through the midnight of the last day of the simulation.
### Maintenance Hit Matrix Report

This report is an exhaustive listing of the maintenance tasks that occurred during your simulation. The columns of the report are:

- **Subsystem Name**
- **Component Name**
- **Task Name**
- **Type of Maintenance**: Preventive or Corrective.
- **Level**: Organizational level type at which the maintenance action will be performed (for example, ORG, DS, GS).
- **Specialty 1**: First Specialty that was assigned to perform the maintenance action.
- **Number**: Number of maintainers of the first Specialty that must work together to perform the task.
- **Specialty 2**: Second Specialty that was assigned to perform the maintenance action.
- **Number**: Number of maintainers of the second Specialty that must work together to perform the task.
• **Occurrence.** The number of times the task was triggered during the simulation, or occurrences.

• **Manhours.** Total maintenance manhours simulated on the maintenance action.

---

**Maintenance Hit Matrix Report**

This maintenance hit matrix also includes maintenance tasks that never occurred. You will identify those actions by noting the zeros in the “Occurrences”, or number of occurrences, column. If many of your tasks have not occurred, it indicates that your simulation did not run long enough for the system to require these maintenance tasks (such as the mean operational units between failure (MOUBF) for the tasks are longer than the simulation time period). This probably indicates that you should lengthen the simulation run, and re-execute the model.

Since maintenance tasks are triggered by comparing their MOUBF to a standard exponential curve of accrued usage on each component in the system, there is some randomness associated with simulating when the maintenance task will occur. For this reason, we recommend that you execute the IMPRINT Pro scenario with a variety of random number seeds to ensure that you have generated a representative set of results.

In the event a need for maintenance is triggered during your model run but it does not trigger an abort (either because the abort % for that maintenance task is set to 0% or because the probability of an abort is too low), the implementation of maintenance will be postponed until the segment has finished. If the model run completes before the segment has a chance to finish, those tasks which were postponed until the end of the segment will never take place thus they will not be reflected in the Maintenance Hit Matrix having occurred.
Contact Team Hit Matrix

The contact team hit matrix report has results displayed only if the maintenance task has been performed at the contact team level.

This report is an exhaustive listing of the maintenance tasks that occurred during your simulation. The report scrolls up and down. The columns of the report are:

- Subsystem Name
- Component Name
- Task Name
- Maintenance Task Type (Preventive or Corrective)
- Specialty that was needed to perform the maintenance action (note that CT is used to denote a member of the crew)
- Number of Contact Team maintainers needed to perform the task
- The number of times the task was triggered during the simulation
- Total maintenance manhours simulated on the maintenance action

If the contact team does not perform any maintenance action for the run then this report does not have any results.
Crew Chief Hit Matrix Report

The Crew Chief Hit Matrix report has results displayed only if the maintenance task has been performed at the crew level.

This report is an exhaustive listing of the maintenance tasks that occurred during your simulation. The report scrolls up and down. The columns of the report are:

- **Subsystem Name**
- **Component Name**
- **Task Name**
- **Maintenance Task Type (Preventive or Corrective)**
- **Specialty that was assigned to perform the maintenance action** (note that CC is used to denote a member of the crew)
- **Number of maintainers needed to perform the task**
- **The number of times the task was triggered during the simulation**
- **Total maintenance manhours simulated on the maintenance action**

If the crew does not perform any maintenance action for the run then this report does not have any results.
Daily Reliability Report

For each day of the scenario, the daily reliability report provides a summary of the number of segments requested, the number of segments accomplished (generated by the simulation), and the percentage of the requested segments that were accomplished.

Similarly, the daily reliability report also provides a summary of the number of systems requested, the number of systems accomplished (generated by the simulation), and the percentage of the requested systems that were accomplished.

For more information on requested and accomplished segments and systems, see the Reliability and Availability Report.
Supply and Support Report

This report contains the fuel and ammunition requirements for supporting a mission. These support requirements are based on the daily fuel and ammunition requirements for a particular scenario entered under Equipment node and the capacity and manpower available per transporter entered in the Scenario mission node. The columns of the report are:

- **Subsystem Name**
- **Transporter Name**
- **Total # of trips needed**
- **Specialty.** First Specialty that was assigned to transport the fuel.
- **Number.** Number of the transporters of the first Specialty that must work together to perform the task.
- **Specialty.** Second Specialty that was assigned to transport the fuel.
- **Number.** Number of the transporters of the second Specialty that must work together to perform the task.
IMPRINT determines the Supply and Support requirements as follows:

1. IMPRINT Pro calculates the Total # of Trips Needed by assessing the systems’ fuel and ammunition usage over the course of the scenario and then by determining how many trips are required to supply for this usage.

2. The total number of trips per scenario is divided by the number of days in the scenario to determine the average number of trips a transporter will make in one day.

3. Dividing the average number of trips per day by the maximum number of trips a transporter can make in one day results in the average number of transporters needed per day. This number is then rounded to the next highest integer.

4. The average number of transporters needed per day is then multiplied by the number of individuals of a set specialty (e.g., MOS 1) who are required to man one transporter at any one time. This results in the total number of warfighters of a particular specialty that are required to run all similar transporters for the entire scenario. This step is repeated for the second specialty, if used.

Maintainability Report

This report includes simulated maintenance manhours per operational hour. This measure is calculated by dividing the total manhours of maintenance performed on each subsystem by the total number of operational hours of the scenario.
This report also includes simulated manhours per hour. This measure is calculated by dividing the total manhours of maintenance performed on each subsystem by the total length of the scenario (in hours).

Maintainability Report

Maintainability Graph

This graph provides a histogram of the manhours needed to perform maintenance on each subsystem of your system. The histogram includes two types of data: 1) the number of maintenance manhours per operational hour (typically referred to as the maintenance ratio), and 2) the number of maintenance manhours per hour of the scenario.

The histogram provides a graphical presentation of the same data that are displayed in the Maintainability report.
Headcount Frequencies Report

This report provides a measure of Specialty utilization, or more specifically, it illustrates the frequency with which different numbers of people in each specialty were used and over all organizational level types (for example, ORG, DS, GS). This report is based on the entire length of the simulation, not just the times during the simulation that this Specialty was busy or on duty.

The highest bin for which a > 0% utilization is shown will never exceed the shift manning levels you set for that Specialty and that organizational level type. Additionally, if the highest bin shown has a relatively high frequency, as in the example of 20% of the time three people being used, then it is possible that you have constrained this Specialty so tightly that it is reducing system availability.
As an example, consider the report shown in the figure above. Notice that in the Specialty column, the results for the 45E20 at the ORG Level show a frequency of 97.29% for the crew size of 0. This means that for most of the scenario time (97.29% of the time), zero 45E20 specialties were in use. By contrast, for 2.19% of the scenario time, at least two people of the 45E20 specialty were in use. If the scenario was 10 days long, then the 45E20 was busy for (2.19% x (240 hours)) = 5.256 hours. The total percentage of time that any 45E20 maintainer was required is 2.71% - this translates to 6.504 hours.

We recommend that you perform the first IMPRINT Pro maintenance model run with the shift manning levels unconstrained. This will result in a simulation that optimizes system availability from the perspective of manpower. Put another way, the simulation will assume that the manpower required to perform any maintenance action will be available. After running the IMPRINT Pro maintenance model in the unconstrained mode, you should examine this Headcount Frequency report for guidance on how to best constrain your shift manning pools (such as to minimize the effect on system availability). We recommend that you focus on reducing manpower pools for Specialties that have low utilizations.

**Manhour Requirements Report**

This report has three columns. They are organizational level, Specialty, and Direct Maintenance Manhours. This report is useful for identifying the Specialties that are performing the most maintenance.
Manhour Requirements Graph

The Manhour Requirement Graph is a histogram that presents the same data as are in the Manhour Requirements Report. Each Specialty at each organization level (GS, ORG and DS) is shown as an individual bar in the histogram. The height of the bar indicates the number of manhours expended by that Specialty at that organizational level throughout the scenario.
Combat Damage Report

This is a brief report that lists the number of combat hits that were simulated for all your systems throughout the entire length of the simulation run. This report also lists the number of simulated attritions, or kills. Finally, this report also shows the required repair time in total number of hours.

It should be noted that these metrics are stochastically driven because of the combat parameters entered earlier in IMPRINT Pro. These combat parameters are mission-specific and include the probability of combat hit per hour, the probability of attrition or repair, and the time it takes to either replace a destroyed system or repair a damaged system.
Logistical Summary Report

The Logistical Summary Report includes two measures. These measures are the amount of time systems spent waiting for spare parts and the amount of time systems spent waiting for maintainers. Each of these measures are reported by organizational level.

If there is an excessive amount of time in which systems are spent waiting for spare parts, you will want to either increase the probability that spares are available or decrease the amount of time required to procure a spare on the Spares tab in Equipment node.

If there is an excessive amount of time in which systems are spent waiting for maintainers, you will either want to increase the number of people in your manpower pools, or you should increase your shift lengths, or you could decrease the operational profile for your systems. Each of these options are available in the Equipment portion of IMPRINT Pro.
Stressor Settings Report

You can apply five different stressors (cold, heat, noise, MOPP, and sleepless hours) to tasks in the Settings option of the Moderators menu. The Stressor Settings report allows you to view all the stressors you set for the model. The report will display the following information:

- **Function Name.** The parent function of the task.
- **Task Name.** The task that the stressor has been applied.
- **Warfighter.** The name of the operator who will perform the task.
- **Specialty.** A three-character designation representing the operator’s specialty.
- **Stressor.** The type of stressor.
- **Level.** The level at which the stressor has been applied.
Specialty Utilization Report - Equipment Model

For users who regularly use the Army Military-Civilian Cost System (AMCOS) to estimate the cost of using a fixed number of military personnel for a specific number of years, the Specialty Utilization Report is designed to provide you information about the utilization of all the specialties in your model run which may then be used as a basis for the data you enter into AMCOS.

In general, AMCOS requires that you enter specialty, the number of people of each specialty, and all years of service to be included in your cost estimate so that it can give you an estimation on how much it costs to support these specialties for those years. After having run an IMPRINT Pro model, you may use the Specialty Utilization Report to gain a better understanding on the types and quantities of personnel you need based on your model run results.

Before entering data into AMCOS based on this report, the idea of "utilization" according to IMPRINT Pro must be understood. In the Maintenance model, utilization is considered to be the total time any maintainer spends actively working on repair tasks (direct maintenance manhours) and is not the amount of time an maintainer is simply available, or in other words, not simply the model run time. Secondly, in the case where a repair task requires more than one person, the utilization is...
considered the total of all maintainers’ hours collectively and not simply the clock time it took for the task to be turned around. For example, if two maintainers both worked on the same repair task for four hours apiece, the total direct maintenance manhours for this task is eight hours. More detailed information about the individual repair tasks performed by maintainers can be found in the Manhours Requirements report, the report on which the Specialty Utilization Report is based.

It is also important to note that the utilization reported by the Specialty Utilization Report is for the total duration of the model; if the total clock time of your model run is any less than one year, the utilization hours reported will not correlate directly with the expected values AMCOS requires, which are specifically the full years that you need a specialty. You must project out from the utilization summary the number of people of a certain specialty you need and the number of years your specialty must be available; this interpolation of the data may require more expertise beyond what the Specialty Utilization Projection Report can provide. The quantities of each specialty and the years for which they are required could vary depending on how many people of each specialty your mission requires and how many similar missions you intend to execute within the course of a year.

AMCOS requires users to enter data in four steps: Properties, Faces and Spaces, Cost Summaries and Output. The part of AMCOS to which your IMPRINT model run results apply is the Faces and Spaces step where you add information about the personnel required. This part of AMCOS is depicted in the image below:

The Faces and Spaces page contains the following fields:

- PayPlan
- Group
The only fields where IMPRINT report data applies are in the **Group**, **Subgroup**, **Grade** and **Inventory** fields.

### Applying IMPRINT Pro report data to AMCOS

*To apply IMPRINT Pro report data to AMCOS:*

1. Select the desired group from the drop-down list.

![Image showing the selection process](image)

**Note:**

In IMPRINT Pro, all specialties from which you may select your Warfighters are grouped together in one list. In AMCOS, however, specialties are categorized into different groups. The first two characters in a specialty code defines the group to which that specialty belongs.

The selected group appears in the **Group** field, and the **SubGroup** drop-down list is enabled.
2. From the **SubGroup** drop-down menu, select the desired subgroup (specialty).

The selected subgroup appears in the **SubGroup** field.

3. From the **Grade** drop-down menu, select the pay grade which applies to the selected Group-SubGroup combination.
If you are basing your selection in AMCOS on the data from the Maintenance Manhour Requirements report, it is important to note that in place of an E-level value for Warfighters, IMPRINT Pro displays a pay grade value instead. These values translate as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>E-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>E1-E3</td>
</tr>
<tr>
<td>20</td>
<td>E4</td>
</tr>
<tr>
<td>30</td>
<td>E5</td>
</tr>
<tr>
<td>40</td>
<td>E6</td>
</tr>
<tr>
<td>50</td>
<td>E7</td>
</tr>
<tr>
<td>60</td>
<td>E8-9</td>
</tr>
</tbody>
</table>

The selected grade appears in the **Grade** field.

4. The Inventory section displays a box for each year you are choosing to project costs. In each box provided, enter the number of personnel for which costs are to be projected.
5. Click the **Insert** button in the lower-left corner of the screen.

The specialty data you entered is added to the list at the top of your AMCOS screen. You may repeat these steps for all specialties to be included in your cost projection. Once you have finished entering specialty information, you are finished with the portion of AMCOS which requires data from IMPRINT. Proceed with the remaining steps in AMCOS as normal.
Chapter 7: Custom Performance Moderators

In IMPRINT Pro you can create your own custom performance moderators to affect time or accuracy of the tasks in your model. A new moderator is added to your analysis as either a new Custom Stressor or a Custom Training Moderator. Each moderator modifies task time and accuracy according to the algorithm you define.

Adding and implementing a new custom moderator first requires identifying the moderator, for example, you may wish to specify a new method of training which makes use of a web-based product rather than using an instructor. In this case, the new method could be added as a new custom training moderator called “Web Training.” Next, the levels of the moderator must be specified, for example, available training options might include once, twice, three times and four times per month in which case four unique levels of impact must be defined for the moderator. Next, each level’s impact must be represented by an algorithm you create - these algorithms link levels of the moderator to performance impacts by taxon and then applying the moderator to the individual tasks as needed. For example, if research supports a theory that more frequent training with this new product enhances the accuracy of tasks requiring cognitive workload, specifically in the areas of information processing and problem solving, an algorithm designed to increase the value of task accuracy as a function of the Information Processing/ Problem Solving taxon would be appropriate.

Once defined a custom moderator is available for use by all Operations and Maintenance models in your analysis. Using Custom Moderators allows you to embed your own experimental findings into an IMPRINT Pro model.

Custom Stressors

The Customs Stressors node is located below the Forces node in the Analysis tree.
Displaying a List of Custom Stressors

_**To display a list of all custom stressors in the main window:**_

In the Analysis Tree, double-click the **Custom Stressors** node.

A list of Custom Stressors will display in the main window.

<table>
<thead>
<tr>
<th>User Stressor Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Stressor1</td>
</tr>
<tr>
<td>User Stressor2</td>
</tr>
</tbody>
</table>

Adding Custom Stressors

_**To add a custom stressor:**_

1. In the Analysis Tree, right-click the **Custom Stressor** node.
2. Select **New Custom Stressor** from the menu that displays.

   IMPRINT Pro adds a Custom Stressor child node to the Analysis Tree below the Custom Stressors node.

   **Note:**
   IMPRINT Pro will name your new stressor **Custom Stressor**. If you continue to add Custom Stressors, each following stressor will be named **StressorX** where X is the next integer.
Deleting Custom Stressors

To delete a stressor:

Do one of the following:

- In the Analysis Tree, right-click the stressor you want to delete, and select **Delete Custom Stressor** from the menu that displays.
- Select the stressor you want to delete, and then click the **Delete** key.

IMPRINT Pro removes the custom stressor child node from below the Custom Stressors node.

Cutting Custom Stressors

To cut a stressor:

1. In the Analysis Tree, right-click the custom stressor you want to cut below the Custom Stressor node.

2. Select **Cut Stressor** from the menu that displays.

When you right-click the Custom Stressor node in the analysis to which you want to move the Custom Stressor, the cut stressor will be highlighted red. When you perform the paste command, the cut Custom Stressor will be removed old position to the new position.

Copying Custom Stressors

To copy a custom stressor:

1. In the Analysis Tree, right-click the custom stressor below the Custom Stressor node.

2. Select **Copy Stressor** from the menu that displays.

The stressor will be copied to the Windows clipboard.
Pasting Custom Stressors

To paste a custom stressor:

1. In the Analysis Tree, right-click the custom stressor node of the analysis to which you want to paste the cut or copied stressor.

2. Select Paste Custom Stressor from the menu that displays.

   The stressor and all its associated data pastes to the Custom Stressor node in the selected analysis.

Displaying the Custom Stressors Dialog Box

The Custom Stressors dialog box is used to create the algorithms needed to affect time or accuracy in the model.

To display the Custom Stressor dialog box:

   Double-click a Custom Stressor (for example, Custom Stressor1).

   The Custom Stressor dialog box displays.
Adding Custom Stressor Levels

To add a custom stressor level:

Do one of the following:

• In the Custom Stressor dialog box, click the Add Level button.
• In the Analysis Tree, right-click Custom Stressor (for example, Custom Stressor1) and select Add Stressor Level from the menu that displays.

A level is added to the dialog box.
Deleting Stressor Levels

To delete a stressor level:

1. In the Custom Stressor dialog box, select the level you want to delete.
2. Click the Delete Level button.

Defining Time and Accuracy

Each level added to your stressor contains two algorithm fields:

- Accuracy Algorithm
- Time Algorithm

These fields contain the algorithms you specify for the level’s effect on task time and accuracy.

Unlike in previous versions of IMPRINT, neither the Custom Stressors nor Training Moderators use “Increase” or “Decrease” fields. Effects on task time and accuracy are instead calculated as follows:

- **Effects on Time.** Any value calculated for a Time Moderator will be added to 1.0, and the result used to multiply the Time value of each task. If the value calculated by the algorithm is positive, task time increases; if the value calculated by the algorithm is negative, task time decreases.
Effects on Accuracy. Any value calculated for an Accuracy Moderator will be subtracted from 1.0, and the result used to multiply the accuracy value of each task. If the value calculated by the algorithm is positive, task accuracy decreases; if the value calculated by the algorithm is negative, task accuracy increases.

Creating Algorithms for Accuracy and Time

A custom stressor algorithm is an expression made up of one or more of the nine taxons available in IMPRINT Pro. As the algorithm is being developed, it may be checked for syntax and tested with numerical replacements for the taxons.

Creating the Algorithm Expression

To create algorithms for accuracy and time:

1. Double-click the Custom Stressor.

2. In the Custom Stressor dialog box, choose a level whose algorithm you wish to add or modify.

3. For the selected level, click the cell under the Accuracy Algorithm column or the Time Algorithm column.

An ellipses displays to the right of the Algorithm box.
4. Click the ellipses \( \ldots \) to the right side of the right side of the algorithm cell.

The Define Accuracy/Time Stressor dialog box displays.
The Custom Stressor name and Stressor Level name appear at the top of the dialog box. The Stressor Level name may be edited as desired by typing a new name directly in the Stressor Level field.

5. Create an equation using the buttons provided in the Algorithm Parameters section of the dialog box. The algorithm displays in the Expression box as it is developed.
6. To save the equation, click **OK**.

The new algorithm displays in the selected algorithm column of the Custom Stressor dialog box.

### Checking Algorithm Syntax

**To check syntax for algorithms for accuracy or time:**

Click the **Check Syntax** button at the bottom of the Custom Stressor dialog box.

The algorithm in the Expression box is checked for syntax errors, and a message displays in the Check Syntax dialog box.

<table>
<thead>
<tr>
<th>Stressor Level</th>
<th>Accuracy Algorithm</th>
<th>Time Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>$\sqrt[4]{42x^2}$</td>
<td>...</td>
</tr>
</tbody>
</table>
Testing Accuracy and Time Algorithms

To test accuracy or time algorithms:

1. Click the Test Algorithm button at the bottom of the Custom Stressor dialog box.

   The Expression field in the dialog box is replaced by the Test Algorithm window.
The Test Algorithm window displays the algorithm at the top. The window also includes Parameter fields corresponding to the nine taxons in IMPRINT Pro tasks, a Calculate button and a Value field.

2. In the enabled taxon fields, enter the values you wish to test for those taxons in the algorithm.

3. Click the Calculate button.

   The resultant value displays in the Value field.
Applying Custom Stressors

*To apply the custom stressors:*

1. From the **Moderators** menu, select **Settings**.
   
   A shortcut menu appears.

2. From the **Settings** shortcut menu, select **Stressors**.
   
   The **Stressors** dialog box displays.

3. For each task that applies, select the desired level of each stressor from the drop-down boxes provided.

Viewing Custom Stressor Results

*To view custom stressor results:*

1. From the **Moderators** menu, select **Results**.
   
   The **PTS Results** dialog box displays.

2. Check the **Stressors** check box on the right hand side of the dialog box.

3. Click the **Apply** button.
   
   The dialog box displays the following values for each task:

   **Previous.** The value(s) before moderators are applied

   **Adjusted.** The value(s) after moderators are applied.

   **Delta.** The difference between the Previous and Adjusted value.
Custom Training Moderators

The Custom Training Moderators node is located below the Forces node in the Analysis tree. Beyond the default training moderators included in the PTS section of IMPRINT, custom training moderators may be applied on a per-task basis rather than per-operator only.

Displaying a List of Custom Training Moderators

To display a list of custom training moderators in the main window:

In the Analysis Tree, double-click the Custom Training Moderators node.

A list of Custom Training Moderators displays in the main window.

Adding Custom Training Moderators

To add a custom training moderator:

1. In the Analysis Tree, right-click the Custom Training Moderator node.
2. Select **New Training Moderator** from the menu that displays.

   IMPRINT Pro adds a Training Moderator child node to the Analysis Tree below the Custom Training Moderators node.

   **Note:**
   IMPRINT Pro will name your new custom training moderator **Training Moderator**. If you continue to add training moderators, each following moderator will be named **Training ModeratorX** where X is the next integer.

**Deleting Custom Training Moderators**

*To delete a stressor:*

Do one of the following:

- In the Analysis Tree, right-click the stressor you want to delete and select **Delete Custom Training Moderator** from the menu which displays.
- Select the stressor you want to delete and click the **Delete** key.

IMPRINT Pro removes the Custom Training Moderator child node from below the Custom Training Moderators node.

**Cutting Custom Training Moderators**

*To cut a stressor:*

1. In the Analysis Tree, right-click the Custom Training Moderator you want to cut below the Custom Training Moderator node.

2. Select **Cut Stressor** from the menu that displays.

   When you right-click the Custom Training Moderator node in the analysis that you want to move the Custom Training Moderator to, the cut Custom Training Moderator will be highlighted red. When you perform the paste command, the cut Custom Training Moderator will be removed old position to the new position.
Copying Custom Training Moderators

To copy a Custom Training Moderator:

1. In the Analysis Tree, right-click the custom training moderator below the Custom Training Moderator node.

2. Select Copy Stressor from the menu that displays.

   The stressor will be copied to the Windows clipboard.

Pasting Custom Training Moderators

To paste a stressor:

1. In the Analysis Tree, right-click the custom training moderator node for the analysis you want to paste to.

2. Select Paste Custom Training Moderator from the menu that displays.

   The stressor and all its associated data will be pasted to the Custom Training Moderator node in analysis you pasted to.

Displaying the Custom Training Moderators Dialog Box

You will use the Custom Training Moderators dialog box to create the algorithms needed to affect time or accuracy in the model.

To display the Custom Training Moderator dialog box:

   Double-click a Custom Training Moderator (for example, Custom Training Moderator1).

   The Custom Training Moderator dialog box displays.
Adding Custom Training Levels

**To add a stressor level:**

Do one of the following:

- In the Custom Training Moderator dialog box, click the Add Level button.
- In the Analysis Tree, right-click Custom Training Moderator (for example, Custom Training Moderator1) and select Add Stressor Level from the menu that displays.

A level is added to the dialog box.

Deleting Custom Training Levels

**To delete a stressor level:**

1. In the Custom Training Moderator dialog box, select the level you want to delete.
2. Click the **Delete Level** button.

**Defining Time and Accuracy**

Each level added to your training moderator contains two algorithm fields:

- **Accuracy Algorithm**
- **Time Algorithm**

These fields contain the algorithms you specify for the level’s effect on task time and accuracy.

Unlike in previous versions of IMPRINT, neither the Custom Stressors nor Training Moderators use “Increase” or “Decrease” fields. Effects on task time and accuracy are instead calculated as follows:

- **Effects on Time.** Any value calculated for a Time Moderator will be added to 1.0, and the result used to multiply the Time value of each task. If the value calculated by the algorithm is positive, task time increases; if the value calculated by the algorithm is negative, task time decreases.

- **Effects on Accuracy.** Any value calculated for an Accuracy Moderator will be subtracted from 1.0, and the result used to multiply the accuracy value of each task. If the value calculated by the algorithm is positive, task accuracy decreases; if the value calculated by the algorithm is negative, task accuracy increases.

**Creating Algorithms for Accuracy and Time**

Similar to the custom stressor algorithm, a custom training moderator algorithm is an expression made up of one or more of the nine taxons available in IMPRINT Pro. Apart from the custom stressor algorithm, however, the custom training moderator allows you the additional option of factoring task difficulty (T) or simply the sum of all the single task demand values into your algorithms. As the algorithm is being developed, it may be checked for syntax and tested with numerical replacements for the taxons.

**Creating the Algorithm Expression**

*To create algorithms for accuracy and time:*

1. Double-click the custom training moderator.
2. In the **Training Moderator** dialog box, choose a level whose algorithm you wish to add or modify.

3. For the selected level, click the cell under the **Accuracy Algorithm** column or the **Time Algorithm** column.

   An ellipses displays to the right of the algorithm box.

![Diagram of Training Moderator](image)

4. Click the ellipses ```...``` to the right side of the right side of the algorithm cell.

   The **Define Accuracy/Time Algorithm** dialog box displays.
5. Create an equation using the buttons provided in the Algorithm Parameters section of the dialog box. The algorithm displays in the **Expression** box as it is developed.

Decimal points must follow a number. Operators must follow a number or workload taxon. The workload taxons you enter into the equation refer to the weights given to the taxons in individual tasks.

To backspace, click **Backspace**.

To clear the equation, click **Clear**.

To cancel the equation, click **Cancel**.
6. To save the equation, click **OK**.

The new algorithm displays in the selected algorithm column of the Custom Training Moderator dialog box.

<table>
<thead>
<tr>
<th>Stressor Level</th>
<th>Accuracy Algorithm</th>
<th>Time Algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level</td>
<td>$\ln(4.21)$</td>
<td></td>
</tr>
</tbody>
</table>

**Checking Algorithm Syntax**

*To check syntax for algorithms for accuracy or time:*

Click the **Check Syntax** button at the bottom of the Custom Stressor dialog box.

The algorithm in the Expression box is checked for syntax errors, and a message displays in the Check Syntax dialog box.
Testing Accuracy and Time Algorithms

To test accuracy or time algorithms:
1. Click the **Test Algorithm** button at the bottom of the Custom Stressor dialog box.

The Expression field in the dialog box is replaced by the **Test Algorithm** window.

The **Test Algorithm** window displays the algorithm at the top. The window also includes **Parameter** fields corresponding to the nine task taxons plus task difficulty, a **Calculate** button and a **Value** field.

2. In the enabled taxon fields, enter the values you wish to test for those taxons in the algorithm.
3. Click the **Calculate** button.

   The resultant value displays in the **Value** field.

   ![Algorithm](image1)

**Using Custom Training Moderator Templates**

IMPRINT Pro includes three pre-defined training moderator templates: **Delivery Method**, **Frequency** and **Recency**. Each template contains four or more unique pre-defined levels appropriate to the template chosen:

- **Delivery Method**: Web-based/remote, Classroom, Simulator-based, Hands on instruction/practice.
- **Frequency**: Once a week or more, 2 or 3 times a month, Once a month, less than once a month, less than twice a year.
- **Recency**: Within days, 30 days, 60 days, Over 3 months.

Use these templates as a starting point to define your custom training moderator.

**To use a custom training moderator template:**

1. Right-mouse click the **Custom Training** node in the **Analysis Tree**.

2. Select one of the following:
   - New Delivery Method Moderator
   - New Recency Moderator
   - New Frequency Moderator
The new custom training moderator appears in the tree.

3. Double-click the new custom training moderator.

A new tab displays, showing the five default levels included with the moderator selected. Edit the name(s) of the moderator and of the training levels contained by it as desired.

4. Add the desired algorithms to the levels provided. For more information see “Creating the Algorithm Expression” on page 444.
Applying Custom Training Moderators

To apply the custom training moderators:

1. From the Moderators menu, select Settings.

   A shortcut menu appears.

2. From the Settings shortcut menu, select Training.

   The Training Settings dialog box displays.

3. Click the Custom Training radio button.

4. For each task that applies, select the desired level of each training moderator from the drop-down boxes provided.

Viewing Custom Training Moderator Results

To view custom training moderator results:

1. From the Moderators menu, select Results.

   The PTS Results dialog box displays.

2. From the Settings shortcut menu, select Training.

   The Training Settings dialog box displays.

3. Check the Training check box on the right hand side of the dialog box.

4. Click the Apply button.

   The dialog box displays the following values for each task:

   Previous. The value(s) before moderators are applied

   Adjusted. The value(s) after moderators are applied.

   Delta. The difference between the Previous and Adjusted value.
Chapter 8: Force Analysis

This chapter describes the IMPRINT Pro Force analysis capability. The chapter is divided into sections that describe how to enter the data needed to describe a force unit, the properties of those force units, settings that control force model execution, methods used to analyze the results data, and how to create reports displaying the results of executing the force model.

The objective of the Force Analysis module is to help you predict the manpower needed to perform the routine and unplanned work done by a force unit. Similar to the Define Equipment module in IMPRINT Pro, the Force Analysis module operates using a stochastic model which relies on various inputs you provide. Inputs required are discussed in the sections below.

Introduction to Force Analysis

To conduct an IMPRINT Pro analysis of a Force Unit, follow these steps:

1. Define a Force Unit.

   The Forces node contains the individual force units you choose to add to your model. A Force Unit is a group of individuals, defined by their job, who perform a variety of activities according to schedules. When more than one schedule exists, these schedules run in parallel when you run the Forces model.

2. Define schedules for your Force Unit.

   When you choose to create a force unit, you might choose to rotate your available personnel through different activities by setting up several different schedules. For example, one group might perform their work activities during the day (schedule A), and a second group might perform their work activities at night while the first group sleeps (schedule B). Although the two different groups operate on different schedules, both groups work together as a force unit to make sure that the work required in a given time period gets done. You can choose to make your force module even more detailed by creating separate schedules for each type of Job you add. For example, if you have a driver, navigator and an analyst all performing on a similar schedule...
during the day, it may be of interest to vary each operator’s schedule slightly so that an activity of “guard duty” is covered by at least one of these individuals throughout the time period. Staggering this activity would result in three slightly different schedules.

3. Develop a list of planned activities to be performed by the Force Unit.

Most of the activities you will add to a schedule will be Planned activities. These activities have a designated start time in your schedule and will last until the next scheduled activity is set to occur. Examples of these activities include “work,” “personal time,” “sleep,” and “hygiene.”

4. Develop a list of unplanned activities to be performed by your Force Unit.

Activities factored into your schedule may also include Unplanned activities, which also have a set start time but whose duration may vary depending on the mean time, standard deviation and distribution you choose to specify in the activity’s properties. Example unplanned activities may include “illness,” “emergency” and any other activity that would interrupt a normal schedule. Unplanned activities may also be set to repeat over time. Unplanned activities require that you specify a minimum number of crew members of which role categories/ are required to respond in order that the unplanned activity may be considered successful.

5. Develop a list of Jobs comprising your Force Unit.

The final component in the Forces module is the set of Jobs you choose to create. As mentioned previously, example jobs may include “Driver,” “Pilot,” “Navigator,” or “Analyst,” all of whom are required to perform activities. The properties of any job you create include a default rank and specialty. For example, the job of “Driver” might be specified as requiring an E5 rank and 19K specialty. The schedule(s) you design might require that you have several such job operators to cover all planned and unplanned activities within it.

6. Assign roles to your jobs.

A person who is able to perform a job may be able to do so in more than one capacity. For example, an individual who is qualified for the job of “Pilot” may also be qualified to be a “Co-pilot” and at times may be required to fill that roll instead. To add this additional latitude within the job, the IMPRINT Pro Forces module includes a set of role categories, which are referred to as Leader, Sub-Leader and Member. When creating jobs, you specify the exact roles existing within each job.
description and the total number of individuals belonging to this job description that you have available for each schedule; these numbers ultimately tell the schedule how many Leaders, Sub-Leaders and Members you have at any one time to respond to an unplanned activity. For example, a schedule may contain an unplanned activity (aerial response to ground attack) requiring 3 Leaders (pilots), 3 Sub-Leaders (co-pilots) and 5 Members (additional crew). If the total number of Leaders among all job operators available to respond to this unplanned activity is less than the required number, the unplanned activity cannot successfully be conducted. This result would then be reported in the reports data provided by IMPRINT Pro after the Forces model is run.

7. Set the Activities Trump Matrix.

For any schedule having both planned and unplanned activities, an unplanned activity will likely conflict with an ongoing planned activity. Only one activity may be performed at any given time. To determine which activity continues and which activity is halted, you must set a priority for each activity pair through the Activities Trump Matrix.

8. Run the Force Analysis model.

You may run the Force Analysis model at any point during the development of your force analysis. Execution options include setting the length of the model run (in days) and changing the random number used.

9. Run the Force Analysis reports.

The Force Analysis reports may be viewed any time after the model has been executed. The Force Analysis reports display data for both planned and unplanned activities.

**Force Analysis Data**

Force Analysis Data consists of the following items:

- **Force Units.** Groups of individuals who perform activities according to a schedule.

- **Schedules.** A pre-defined sequence of activities, planned and unplanned, over a specific amount of time.
- **Planned Activities.** Routine tasks. Examples may include guard duty, hygiene, eating and sleeping.

- **Unplanned Activities.** Activities interrupting a normal schedule. Examples may include fire and emergency.

- **Activities Trump Matrix.** A matrix used to set task priority within a schedule for when any two activities overlap.

- **Jobs.** The occupations held by one or more members of the Force Unit. Each job is defined by a name, specialty, rank and role. Examples may include Tank Driver, Navigator and Analyst.

## Force Units

Force Units are the first sub-nodes located under the Forces node in the Analysis Tree.

## Displaying Force Units

*To display forces in the Analysis Tree:*

In the Analysis Tree, right-click the + adjacent to Forces node.

The forces defined for your analysis display in a list below the Forces node.

![Forces node with two force units](image)

## Adding Force Units

*To add a force unit:*

1. Right-click the Forces node in the Analysis Tree.

2. Select **Add Force Unit** from the menu that displays.
A new Force Unit displays in the list below the Forces node.

Displaying Force Unit Properties

To display Force Unit Information:

To view force unit properties, double-click the desired force unit - a list of force units for the currently-selected analysis displays in the main Pro window. Also displayed are the Number of Schedules defined for each force unit.

<table>
<thead>
<tr>
<th>Unit Name</th>
<th>Number of Schedules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force Unit 1</td>
<td>3</td>
</tr>
<tr>
<td>Force Unit 2</td>
<td>2</td>
</tr>
</tbody>
</table>

Schedules

For each force unit defined, you may define an unlimited number of schedules. A schedule corresponds to a sequence of activities which will be common to one or more job operators for a specified number of days. As an example, a force unit that is divided into two groups might have one group operating on a daytime schedule (shown below) where crew members are doing work-related activities during the day and sleeping at night while the other group assumes a second schedule in which work-related activities are performed at night and sleep occurs during the day.
Sample schedule:

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00 - 6:00AM</td>
<td>Sleep</td>
</tr>
<tr>
<td>6:00AM-8:00AM</td>
<td>Hygiene</td>
</tr>
<tr>
<td>8:00AM-12:00PM</td>
<td>Guard</td>
</tr>
<tr>
<td>12:00PM-4:00PM</td>
<td>Personal Time</td>
</tr>
<tr>
<td>4:00PM-8:00PM</td>
<td>Guard</td>
</tr>
<tr>
<td>8:00PM-10:00PM</td>
<td>Personal Time</td>
</tr>
<tr>
<td>10:00PM -12:00AM</td>
<td>Hygiene</td>
</tr>
</tbody>
</table>

In the IMPRINT Pro Forces module, these schedules appear simply a timeline representing any length of time. For every activity added, a start time is required. The duration of any single activity is automatically set to the number of hours between its own start time and the start of the next scheduled activity so that all minutes in the schedule are accounted for.

For more information see “Adding Planned Activities to a Schedule” on page 464.
Displaying a List of Schedules

To display a list of schedules for the selected force unit:

Double-click the Force Unit node in the Analysis Tree.

A list of schedules displays in the main IMPRINT Pro window.

For each schedule defined, the duration of the schedule displays in the adjacent box. The duration corresponds to the number of days the schedule runs.

When you run the Forces model for a particular force unit, all schedules corresponding to the unit run in parallel. Any schedule having a duration less than the duration of the model run will repeat until the model run ends.

Adding a Schedule

To add a Schedule:

In the Force Unit properties window, click the Add Schedule button.

A new schedule listing appears in the Schedules list.
Deleting a Schedule

To delete a Schedule:

In the Force Unit properties window, click the **Delete Schedule** button.

The selected schedule disappears from the Schedules list.

Force Activities

Each force unit may have its own defined list of activities that are performed in a schedule. Activities belong to one of two categories: **Planned** and **Unplanned**. A planned activity is one which is set to occur at a specific clock time and lasts for a specific number of hours in your schedule. Unplanned activities are also driven by a user-specific Start times. Their durations, however, are controlled by Mean, Standard Deviation and Distribution parameters set in the Unplanned Activities properties box. When an unplanned activity comes up, the current ongoing planned activity will be overtaken or “trumped” if the new activity has the higher priority according to the **Activities Trump Matrix**.
Displaying Activity Categories

To display activity categories:

Click the + adjacent to Activities node.

The following activity categories appear below the Activities node:

- **Planned.** An activity which is set to occur at a specific clock time and lasts for a specific number of hours in your schedule.
- **Unplanned.** An activity which is set to occur at a specific clock time but whose duration is controlled by Mean, Standard Deviation and Distribution parameters set in the Unplanned Activities properties box.

Planned Activities

A planned activity is an activity which is set to occur at a specific clock time and lasts for a specific number of hours in your schedule.

See:

- Displaying Planned Activities
- Adding a Planned Activity
- Displaying and Editing Planned Activity Properties
- Deleting a Planned Activity
**Displaying Planned Activities**

*To display a list of planned activities:*

Click the `+` adjacent to Planned node.

A list of planned activities lists below the Planned node in the tree.

**Adding a Planned Activity**

*To add a planned activity:*

1. Right-click the Planned node.

2. Select *Add Planned Activity* from the menu that appears.

A new planned activity appears underneath the Planned node.

Double-click the listed activity to view its properties in the main IMPRINT Pro window.
Displaying and Editing Planned Activity Properties

To display Planned Activity properties:

Double-click the desired planned activity under the Planned node in the Analysis Tree.

The properties of the planned activity display in the main Pro window. Properties include:

- **Unit Name.** The unit to which the planned activity is assigned.
- **Activity.** The name of the activity performed.
- **Sleep Activity.** A flag for indicating whether or not the activity involves sleep. In the event a schedule requires one or more job operators for which more than the required number of equally-qualified operators are available, the operators considered to be the least fatigued, i.e., who most recently participated in Sleep Activity, are called on to perform in the schedule.

The properties of an activity may be changed as desired either through the activities window or properties window. To edit the name of an activity, simply type the new name in the Activity field. To edit the Sleep state, click the drop-down arrow, and select the desired option from the list.

Changing the properties through the Activities window.

Changing the activity properties through the Properties window.
Deleting a Planned Activity

To delete a planned activity:

1. Right-click the desired planned activity in the Analysis Tree.
2. Select **Delete Planned Activity** from the menu that appears.

   A selected activity disappears underneath the **Planned** node.

Adding Planned Activities to a Schedule

Any activity added underneath the Planned category may be added to one or more schedules you define for your force. Before adding these activities into your schedule, you must first define them in the Activities node under the categories of Planned. For more information, see “Force Activities” on page 460.

A schedule represents a fixed amount of time over which a set of serialized activities are performed. When a new activity is added to a schedule, that activity consists of a Start time and an End time within that fixed time period. The same activity may be added to a single schedule more than once.
To add planned activities to your schedule:

1. Double-click the Planned node in the Analysis Tree.

   The Schedules tab appears in the main window, containing a separate sub-tab for each schedule you add under your force unit node.

2. Click the corresponding schedule tab to which activities are to be added.

3. Click the Add Activity button to add activities to your schedule.

   A new activity row appears in the schedule, displaying the default activity name, Start Time and End Time.

4. Click the cell of the desired activity listing to view a drop-down list of activities from which to choose. Available activities include those which are defined under the Planned activities node.
5. Continue adding activities to your schedule as desired.

6. Enter the Start Time for your activity. Times are in hours and minutes (HH:MM).
IMPRINT Pro automatically sets the End Time for each activity to match the Start Time of the next activity set to occur, eliminating any gaps in the schedule.

**Removing a Scheduled Activity**

To remove scheduled activities:

1. Click the tab corresponding to the schedule to which an activity is to be removed.
2. Click the desired activity to select it.

3. Click the **Remove Activity** button.

The selected activity is removed from the schedule.

**Unplanned Activities**

Unplanned activities are those which are set to occur at specific clock times but whose likelihood to occur and duration are controlled by Mean, Standard Deviation and Distribution parameters. These activities represent interruptions to the normal schedule and add variability, for example emergencies, illnesses and unforeseen threats. Unplanned activities have additional properties for being repeatable and for requiring a minimum number of job operators of specific role categories.

**Viewing Unplanned Activities**

*To view unplanned activities,*

Click the + adjacent to Unplanned node.

A list of unplanned activities lists below the unplanned node in the tree.

Alternatively, you may double-click the Unplanned node to see a list of these activities in the main Pro window.
This window also displays all properties of your activities in a tabular format. You may edit properties of your unplanned activities in this interface or by opening up the properties window for each task separately.

**Adding an Unplanned Activity**

*To add an unplanned activity:*

1. Right-click the **Unplanned** node.

2. Select **Add Unplanned Activity** from the menu that appears.

A new unplanned activity appears underneath the unplanned node.

**Displaying and Editing Properties of an Unplanned Activity**

*To display Unplanned Activity properties:*

Double-click the desired planned activity under the **unplanned** node in the Analysis Tree.

The properties of the unplanned activity display in the main Pro window. Properties include:

- **Unit Name.** The unit to which the unplanned activity is assigned.
- **Activity.** The name of the activity performed.
• **Sleep Activity.** A flag for indicating whether or not the activity involves sleep. In the event a schedule requires one or more job operators for which more than the required number of equally-qualified operators are available, the operator(s) considered to be the least fatigued, i.e., the operator(s) who gets the most sleep up until the actual point of time of the unplanned activity on the same day of the activity are called on to perform the unplanned activity in the schedule. For example, in the case where a Driver and Gunner have both received 8 hours of sleep before an unplanned activity on Day 1 in a schedule, both would be equally qualified to handle the unplanned activity in which case one operator will be pulled at random to address the activity. In the event the entirety of Driver’s sleep was in Day 1 (16:00-24:00), and part of Gunner’s sleep started on Day 1 (20:00-24:00) but continued into Day 2 (00:00-04:00), an unplanned activity occurring on Day 2 at 05:00 would cause the Gunner to be pulled since the Gunner has had more sleep than Driver on the actual day of the activity up until the point of the unplanned activity (four hours total).

• **Interrupt Strategy.** A flag indicating whether an unplanned activity can [resume](#) or must [restart](#) if the personnel available to man this activity changes since its start. For example, assume an unplanned activity occurs which requires a fixed number of leaders, subleaders and members from a pool of available personnel. If a second unplanned activity occurs which also requires a fixed number of personnel, IMPRINT Pro checks to see if any unused personnel remain in the pool available to all unplanned activities or if excess personnel (any beyond the required minimum) must instead be pulled from the first (or any other) unplanned activity. If personnel must be pulled from the first unplanned activity and there are enough of them to man the second unplanned activity, those excess personnel will be assigned to the second activity as required. Since the number of personnel assigned to the first unplanned activity has now changed since the activity started, IMPRINT Pro either restarts or resumes this activity based on the value you set in this field.

• **Duration.** The amount of time the activity lasts, entered as a mean time. You may optionally add a standard deviation and distribution type to add variability to your activity duration.

• **Repeating Activity.** An option indicating the activity repeats. If this box is selected, enter the amount of time after which the activity should repeat since it last started. You may optionally add a standard deviation and distribution type to add variability to your repeat mean time.

• **Manning.** The number of required and desired crew members types for this activity. Crew member types include [Leader](#), [Sub-Leader](#) and [Member](#). These designations are specified in the properties of the jobs you add to your Force Unit.
Chapter 8: Force Analysis

- **Schedule Start Time/Day.** The time and day on which the unplanned activity is set to occur. If a standard deviation and distribution type have been selected for your activity, the time you set in the Start Time and Day fields will act as an approximate time.

- **Schedule Cancel Time/Day.** The cancellation time of an unplanned activity. At the start time of the unplanned activity, IMPRINT Pro checks to see if the required number of people specified in the Manning category can be met. If the required number can be met, the activity proceeds. If the required number cannot be met, the start of the activity is delayed by 15 minutes, and a status entry appears in the Unplanned Activity Status report indicating as such at the corresponding clock time. IMPRINT Pro will then continue to check every 15 minutes afterwards to see if the required can be met until the Cancellation time arrives. If the required number still cannot be met by the Cancellation time, the unplanned activity is cancelled, and the activity is noted as “failed” in the output reports.

- **Stop(End) Time/Day.** The time and day on which the unplanned activity in progress must stop.

To edit a property where a box exists, simply enter the value in the box.

| Standard Deviation | 00:30 HH:MM | Distribution | Normal |

To edit a property from a list, click the arrow on the right-hand side of the property field, and then from the list which appears select the desired value.

The following is an example of an unplanned activity entitled “Emergency Response”. This activity is not a sleep activity. If the personnel available for this activity changes after the start of the activity but the minimum required is still available, the response to the activity resumes with those personnel still available to address the activity. The mean time for this activity is approximately three hours, and it is set to
repeat approximately every eight hours until the start of day three. In order for this activity to successfully occur, a minimum of one leader, two Sub-Leaders and three Members must be available before the cancellation time and day (hour 1 on day 1).

Deleting an Unplanned Activity

To delete a unplanned activity:

1. Right-click the unplanned activity in the Analysis Tree.

2. Select \textit{Delete Unplanned Activity} from the menu that appears.

A selected activity disappears underneath the \textit{Unplanned} node.

Activities Trump Matrix

The Activities Trump Matrix displays all activities in a single matrix which is useful for determining which activity, planned or unplanned, has priority over another activity, essentially “trumping” it. All activities are listed along the top-most row and left-most column and are divided into subcategories of Planned and Unplanned. At the intersection of the column representing your first activity and the row representing your second activity is the name of the activity that takes priority when both are set to occur simultaneously.
Chapter 8: Force Analysis

Displaying the Activities Trump Matrix

*To display the Activities Trump Matrix*

Double-click the Activities node in the Analysis Tree.

A matrix showing all activities, both planned and unplanned, displays in the main window.

<table>
<thead>
<tr>
<th>Planned Activities</th>
<th>Guard</th>
<th>Hygiene</th>
<th>Personal Time</th>
<th>Sleep</th>
<th>Emergency Response</th>
<th>Fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hygiene</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unplanned Activities</td>
<td>Emergency Response</td>
<td>Fire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Changing the Trumping Activity

*To change the trumping activity:*

1. Locate the cell in your matrix which corresponds to the two activities in conflict.
2. Click the cell to display a drop-down list containing both activity names.
3. Click the name of the activity to have priority.

The selected activity now displays in the cell.
In this example, an emergency response or a fire trumps all other planned activities. Between these two activities, however, a fire takes priority over an emergency response.

<table>
<thead>
<tr>
<th>Jobs</th>
<th>Planned Activities</th>
<th>Unplanned Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guard</td>
<td>Hygiene</td>
<td>Personal Time</td>
</tr>
<tr>
<td>Hygiene</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Jobs**

A job is an occupation held by one or more members of the Force Unit. Examples of jobs include Tank Driver, Gunner, and Navigator. For each job in a force unit, you will need to specify the rank and specialty required for that job.

You must also define the role (i.e., level of participation) or roles that this job will fill should an unplanned activity occur. Roles are Leader, Sub-Leader and Member. When the Force model runs through its planned activities, unplanned activities will also occur; to meet the needs of the unplanned activity, Leaders, Sub-Leaders and Members of all job types must be interrupted from what they are doing to address this activity. The number of warfighters of each job description that you make available for each schedule will greatly determine the success in meeting these activities.

Once a job is described, for each schedule in the force unit you must indicate the number of warfighters of this job type that need to be available during each of the schedules defined for this force unit.
Chapter 8: Force Analysis

Displaying Jobs

To display jobs:

Click the + adjacent to Jobs node.

Jobs appear below the Activities node.

Adding Jobs

To add a job:

1. Right-click the Jobs node.

2. Select Add Job from the menu that appears.

A new job appears underneath the Jobs node.

Displaying and Editing Job Properties

To display Job properties:

Double-click the job under the Jobs node in the Analysis Tree.

The properties of the selected job display in the main Pro window. Properties include:
• **Name.** The job name. This is a brief description of the overall activity the crew member performs in this role, for example: Driver, Gunner or Navigator.

• **Rank.** The rank, or official standing, of the crewmember that may perform this job. You may select a rank by clicking the cell to display the drop-down list. Options include: E1-E3, E4, E5, E6, E7 and E8-E9.

• **Specialty.** The crewmember specialty required for the job. Available specialties include the default specialty 00A plus any additional specialties added under the Warfighters node of your analysis.

• **Role.** The level of participation an individual in a job will have in an unplanned activity if one occurs. This participation can be one or more of the following types: **Leader, Sub-Leader and Member.** A crewmember may be assigned one or more roles in the same job profile. When the crew member is factored into the schedule to perform a job, however, he or she may be called out to help address an unplanned activity that pops up, such as a fire or an emergency. This unplanned activity will require a specific number of leaders, sub-leaders and members in order to be addressed. A crewmember may act in only one of those roles at any time. For example, an unplanned activity requiring five 19K E-6 crew members could require that at least two of those crewmembers be designated Leaders and three Members. A crew member who fulfills the requirements of the Leader may not simultaneously fulfill the additional requirement of a Member.

• **Schedule Availability.** The number of available operators of this job, by schedule.

To edit a property where a box exists, enter the value in the box.

<table>
<thead>
<tr>
<th>Name: Driver</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank: E1to3</td>
</tr>
<tr>
<td>Specialty: 00A</td>
</tr>
</tbody>
</table>

To edit a property from a list, click the arrow on the right-hand side of the property field, and then from the list that appears select the value.
Running the Force Analysis Model

Once you have created your activities, schedule, and jobs for your force unit, you are ready to run the force model.

When you run the Forces model for a particular force unit, all schedules corresponding to the unit run in parallel for the number of days you set in the Execution window. Any schedule having a duration less than the duration of the model run will repeat until the model run ends.

Setting the Force Model Execution Settings

Prior to running your Force model, you may want to check and/or alter the execution settings for the model run.

To display Force model execution settings:

1. Confirm a Force unit is selected in the tree.
2. From the Execution menu, select the Settings.
   
   The Execution Settings window appears, containing three tabs. Each tab corresponds to a different type of model you can run in IMPRINT Pro.

3. Click the Force Model tab.

   The following execution settings display:

   - **Force Unit.** The force unit selected for the model run. To change the force unit click, the drop-down arrow in the field provided, and then select the unit from the list.
**Length of Run.** The number of days the schedules continue to run when you run the model. To change the desired length of run, type in the desired length in days in the box.

**Random Number Seed.** The random number seed used in combination with the mean times, standard deviation and distribution types for unplanned activities to add variability to your activity times. To change the desired random number seed, type in the desired seed number in the box.

---

**Executing the Forces Model**

*To execute a force model:*

1. Select the desired force unit in the **Force Model Execution Settings** tab.

2. Set the **Length of Run** and **Random Number Seed** as desired.

3. Click the **Play** button in the tool bar at the top of the IMPRINT Pro application window.

The Output window displays simulation run data as the model runs. Once the model run completes, a “Simulation Complete” message appears at the bottom of the window.
Viewing Force Analysis Reports

After running the force model for the desired force unit, you can view the results of your model run using the Reports option.

**Note:**
Running and viewing reports following a model run requires that the user wishing to run and view those reports has the lock on the analysis containing that model. For any model which is unlocked or which is locked by another user on your network, reports will not be available after the model run. For more information on locking and unlocking analyses, see the *IMPRINT Pro User Guide Volume 1: Basic Procedures, Appendix D: Local Server and Remote Server Setup.*

**To view force analysis reports:**

1. From the **Reports** menu, select **Force Model Results**.
   
   A dialog box appears, showing all available reports for your model run.

2. Select the check boxes of the reports you want to view, and then click the **Ok** button.

   Microsoft Excel launches, and the reports you selected appear as separate sheets in a workbook. Click the tab at the bottom of the workbook corresponding to the report you want to view.
Activity Detail Report

The Activity Detail report provides data on each instance of an activity. Instances may be entire activity cycles (start through end) or any portion of the activity cycle in which case an activity occurs (resume through suspend, resume through end). You may choose to display activity details for planned activities, unplanned activities or both.

- **Job.** The job leader, sub-leader and/or member participating in the ongoing planned activity. Each individual belonging to a particular job is tagged for trackability. For example, if three Drivers having identical properties are made available for Schedule 1, and all three drivers are used in the planned activity, then the three individual operators would be tagged as Driver[1], Driver[2] and Driver[3].

- **Schedule.** The schedule to which the job belongs.

- **Activity.** The ongoing activity.

- **Start Day.** The day in the model run that the activity started.
Chapter 8: Force Analysis

- **Start Time.** The time on the Start Day that the activity started.
- **End Day.** The day in the model run that the activity ended.
- **End Time.** The time on the End Day that the activity ended.
- **Duration.** The time elapsed between the activity Start Day/Time and the activity End Day/Time.

### Total Time by Job Report

The Activity Time Total by Job by Schedule report tells you how much time each job spends on each activity, by schedule, both cumulatively and on average. For example, you can find out how much time all Drivers in Schedule 1 spent on the activity “Personal Time,” as a group and as individuals, over the course of the model run.

This report includes the following data:

<table>
<thead>
<tr>
<th>Job</th>
<th>Schedule</th>
<th>Activity</th>
<th>Start Day</th>
<th>Start Time (Hour)</th>
<th>End Day</th>
<th>End Time (Hour)</th>
<th>Activity T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Emergency Response</td>
<td>1</td>
<td>6:46:7</td>
<td>1</td>
<td>11:06:7</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Emergency Response</td>
<td>1</td>
<td>16:24:1</td>
<td>1</td>
<td>19:24:1</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Fire</td>
<td>1</td>
<td>0:0:0</td>
<td>1</td>
<td>1:57:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Guard</td>
<td>1</td>
<td>1:1:0</td>
<td>1</td>
<td>8:46:7</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Guard</td>
<td>1</td>
<td>11:0:0</td>
<td>1</td>
<td>12:0:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Guard</td>
<td>1</td>
<td>16:0:0</td>
<td>1</td>
<td>16:24:1</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Guard</td>
<td>1</td>
<td>19:59:5</td>
<td>1</td>
<td>20:0:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Hygiene</td>
<td>1</td>
<td>6:0:0</td>
<td>1</td>
<td>8:0:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Hygiene</td>
<td>1</td>
<td>22:0:0</td>
<td>1</td>
<td>24:0:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Personal Time</td>
<td>1</td>
<td>12:0:0</td>
<td>1</td>
<td>15:0:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Personal Time</td>
<td>1</td>
<td>20:0:0</td>
<td>1</td>
<td>22:0:0</td>
<td></td>
</tr>
<tr>
<td>Analyst1</td>
<td>Scheduled1</td>
<td>Sleep</td>
<td>1</td>
<td>1:57:0</td>
<td>1</td>
<td>6:0:0</td>
<td></td>
</tr>
<tr>
<td>Driver1</td>
<td>Scheduled1</td>
<td>Emergency Response</td>
<td>1</td>
<td>8:46:7</td>
<td>1</td>
<td>11:06:7</td>
<td></td>
</tr>
<tr>
<td>Driver1</td>
<td>Scheduled1</td>
<td>Emergency Response</td>
<td>1</td>
<td>16:24:1</td>
<td>1</td>
<td>19:24:1</td>
<td></td>
</tr>
<tr>
<td>Driver1</td>
<td>Scheduled1</td>
<td>Fat</td>
<td>1</td>
<td>0:0:0</td>
<td>1</td>
<td>1:57:0</td>
<td></td>
</tr>
<tr>
<td>Driver1</td>
<td>Scheduled1</td>
<td>Guard</td>
<td>1</td>
<td>8:0:0</td>
<td>1</td>
<td>8:46:7</td>
<td></td>
</tr>
</tbody>
</table>

**Activity Detail Report**
Job. The job leader, sub-leader and/or member participating in the ongoing planned activity. Each individual belonging to a particular job is tagged for trackability. For example, if three Drivers having identical properties are made available for Schedule 1, and all three drivers are used in the planned activity, then the three individual operators would be tagged as Driver[1], Driver[2] and Driver[3].

Schedule Name. The schedule to which the job belongs.

Activity. The activity being performed.

# of Jobs. The number of people who participated in the activity over the course of the model run.

Min Activity Time (Hours). The minimum amount of time that any job performer of the designated job type spent on the listed activity.

Max Activity Time (Hours). The maximum amount of time that any job performer of the designated job type spent on the listed activity.

Total Activity Time. The cumulative amount of time spent on the listed activity by all personnel of the same job type and schedule, over the course of the entire model run.

If an activity is added to a schedule multiple times or if it repeats during the course of the model run, the Total Activity Time reflects the cumulative amount of time all instances of this activity lasted. This total does not include any time elapsed when the activity is suspended.

Average Activity Time. The average amount of time a single participant of a particular job type and schedule spent on the listed activity. This amount is calculated as the Total Activity Time divided by the # of Jobs.
The same information displays in the form of a bar chart called the Time Total by Job Chart.
Total Time by Schedule Report

The Activity Time Total by Schedule report is an easy way to see how different schedules portion out time for the same activity, regardless of job type. For example, the activity “sleep” might take an average of 8 hours in a 24-hour schedule while it takes an average of 6 hours in a different 24-hour schedule.

- **Schedule Name.** The schedule to which the job belongs.
- **Activity.** The activity being performed.
- **# of Jobs.** The number of people, from all jobs, who participated in the activity over the course of the model run.
- **Min Activity Time (Hours).** The minimum amount of time that any job performer spent on the listed activity.
Max Activity Time (Hours). The maximum amount of time that any job performer spent on the listed activity.

Total Activity Time (Hours). The total amount of time spent on a particular activity by all personnel within the same schedule over the course of the entire model run. If an activity is added to a schedule multiple times or if it repeats during the course of the model run, the Total Activity Time reflects the cumulative amount of time all instances of this activity lasted. This total does not include any time elapsed when the activity is suspended.

Average Activity Time (Hours). The average amount of time an individual job performer on the designated schedule spends on the listed activity. This amount is equivalent to the Total Time divided by the number of people assigned to this schedule.
Time Total by Individual Job

The Time Total by Individual Job report tells you how much total time was spent on a given activity by an individual job participant from a specific schedule, over the entire course of the model run. For example, you can find out how much cumulative time Gunner #2 (Gunner[2]) from Schedule 4 spent on the activity “Training” over the entire course of the model run. If the job performer performs the activity multiple times or if the activity repeats during the course of the model run, all instances of the activity are reflected in this total. This total does not include any time elapsed when the activity is suspended.

This report includes the following data:

- **Job.** The job leader, sub-leader and/or member participating in the ongoing planned activity. Each individual belonging to a particular job is tagged for trackability. For example, if three Drivers having identical properties are made available for Schedule 1 and all three drivers are used in the planned activity, then the three individual operators would be tagged as Driver[1], Driver[2] and Driver[3].

- **Schedule.** The schedule to which the job belongs.

- **Activity.** The ongoing activity.
Total Time. The total amount of time a single job participant spent on the listed activity.

The Unplanned Activities Status report displays the ongoing status of any unplanned activities which are either in progress or are delayed due to insufficient Job Leaders, Sub-Leaders or Members available to address the activity.

When an unplanned activity’s required minimum personnel cannot be met, the model will check every 15 minutes during the run for the availability of required personnel to meet the unplanned activity. If the required personnel are available, the activity resumes. If the required personnel are unavailable, the status reports as “Delayed”. If the Stop Time or the Cancellation Time of the unplanned activity arrives before the activity can be addressed, the activity status reports as “Failed”. Any activity which is trumped by a higher-priority activity will initially report as “Interrupted” and then “Delayed” until the required minimum can be met or until the activity’s Stop Time or Cancellation Time arrives.

Activity. The ongoing unplanned activity.
- **Start Day.** The day in the model run that the activity started.

- **Clock (Hours).** The clock time at which a change in an activity status occurs and is being reported.

- **Status.** The current state of the activity at the reported clock time. Possible status reports include the following:

  - **Scheduled.** The time at which the unplanned activity is scheduled to occur and when the first check is made to see if the minimum personnel required for the activity (leaders, subleaders and members) can be met. If the minimum required personnel can be met, the activity starts, and the status to follow is “Started”.

  - **Started.** The required personnel for the activity can be met, and the activity begins at the listed clock time.

  - **Interrupted.** The activity is trumped by a higher-priority activity. The status following an interrupted activity is “Delayed”.

  - **Delayed.** The ongoing activity is temporarily suspended due to the unavailability of required personnel. Following the delay, the model will continue to check every 15 minutes for the required personnel until either the minimum personnel are met and the activity starts or until the Cancellation Time is reached at which point the activity is terminated.

  - **Successful.** The ongoing activity completes at the listed clock time.

  - **Failed.** The activity’s cancellation time arrives before the Manning requirements can be met, and the activity is terminated.

- **Roles Not Met.** The roles required by the unplanned activity which could not be met display in this column. The roles listed are “leader,” “subleaders” and/or “members”; quantities unmet, however, are not listed.
Chapter 8: Force Analysis

Specialty Utilization Report - Forces Model

For users who regularly use the Army Military-Civilian Cost System (AMCOS) to estimate the cost of using a fixed number of military personnel for a specific number of years, the Specialty Utilization Report is designed to provide you information about the utilization of all the specialties in your model run which may then be used as a basis for the data you enter into AMCOS.

In general, AMCOS requires that you enter specialty, the number of people of each specialty, and all years of service to be included in your cost estimate so that it can give you an estimation on how much it costs to support these specialties for those years. After having run an IMPRINT Pro model, you may use the Specialty Utilization Report to gain a better understanding on the types and quantities of personnel you need based on your model run results.
Before entering data into AMCOS based on this report, the idea of “utilization” according to IMPRINT Pro must be understood. In the Forces model, utilization is considered to be the total time a job, for example “Driver” (all leaders, subleaders and members of this job type, combined) spends on unplanned activities and is not the amount of time an job is simply scheduled for regular planned activities. In the case where an unplanned activity is trumped by another unplanned activity, resulting in the first activity’s suspension, the initial time spent on the first unplanned activity is still counted towards the utilization time total; the amount of time of the suspension, however, is not unless the trumping activity is also an unplanned activity. In this case, only those job performers who left the first activity to participate in the trumping activity will have their time counted; any leftover leaders, subleaders and members from the first activity who are not utilized for the second will not be counted in the second. In short, the utilization is a sum of all time the job spent performing any unplanned activity within the force unit. More detailed information about the individual tasks performed by an individual job can be found in the Unplanned Activity Detail report, the report on which the Specialty Utilization Report is based.

It is also important to note that the utilization reported by the Specialty Utilization Report is for the total duration of the model; if the total clock time of your model run is any less than one year, the utilization hours reported will not correlate directly with the expected values AMCOS requires, which are specifically the full years that you need a specialty. You must project out from the utilization summary the number of people of a certain specialty you need and the number of years your specialty must be available; this interpolation of the data may require more expertise beyond what the Specialty Utilization Projection Report can provide. The quantities of each specialty and the years for which they are required could vary depending on how many people of each specialty your mission requires and how many similar missions you intend to execute within the course of a year.

AMCOS requires users to enter data in four steps: Properties, Faces and Spaces, Cost Summaries and Output. The part of AMCOS to which your IMPRINT model run results apply is the Faces and Spaces step where you add information about the personnel required.

This part of AMCOS is depicted in the image below:
The Faces and Spaces page contains the following fields:

- PayPlan
- Group
- Subgroup
- Area
- Locality
- Grade
- Inventory

The only fields where IMPRINT report data applies are in the **Group**, **Subgroup**, **Grade** and **Inventory** fields.

**Applying IMPRINT Pro report data to AMCOS**

_To apply IMPRINT Pro report data to AMCOS:_

1. Select the desired group from the drop-down list.
Note:
In IMPRINT Pro, all specialties from which you may select your Warfighters are grouped together in one list. In AMCOS, however, specialties are categorized into different groups. The first two characters in a specialty code defines the group to which that specialty belongs.

The selected group appears in the **Group** field, and the **SubGroup** drop-down list is enabled.

2. From the **SubGroup** drop-down menu, select the desired subgroup (specialty).
The selected subgroup appears in the **SubGroup** field.

3. From the **Grade** drop-down menu, select the pay grade which applies to the selected Group-SubGroup combination. It should be noted that in the IMPRINT Pro Forces model, the grade, also referred to as the “E-level” or “rank”, is attached to any job you create through the **Rank** field in the Job properties window.
The selected grade appears in the **Grade** field.

4. The Inventory section displays a box for each year you are choosing to project costs. In each box provided, enter the number of personnel for which costs are to be projected.
5. Click the **Insert** button in the lower-left corner of the screen.

The specialty data you entered is added to the list at the top of your AMCOS screen. You may repeat these steps for all specialties to be included in your cost projection. Once you have finished entering specialty information, you are finished with the portion of AMCOS which requires data from IMPRINT. Proceed with the remaining steps in AMCOS as normal.
Chapter 9: Plugins

IMPRINT Pro contains a powerful plugin interface that allows developers to extend the runtime functionality of the simulator. This API provides extensibility and flexibility that far exceed the External Model Call functionality of IMPRINT 7, yet is much easier to create, debug and use.

Using Plugins

In IMPRINT Pro, using plugins in a model is simply a matter of calling a method defined on a plugin object, passing to it those values desired, and using the result (if any). This can be done from any code window in the program: Effects, Release Conditions, or Expressions.

The syntax for using a plugin method in a code window is:

```
ExternalVariables.<PluginName>.<PluginMethodName>(<parameters>)
```

If the plugin method returns a value, it can be assigned to any local or global Imprint Variable, just as with any method:

```
int cubeValue = ExternalVariables.ExtraMath.Cube(3);
```
Any public method defined in the plugin class will be available to all analyses in IMPRINT Pro. Any use of a plugin method will be checked for type compatibility by the Syntax Checker, so that modelers will know immediately if there are problems with their code.

Creating Plugins

IMPRINT Plugins are code libraries (.dll files) that are loaded when IMPRINT Pro is launched. In order to be recognized by the Plugin Loader, all of the following must be true:

- The .dll file must be created in the Microsoft .NET framework.
- The assembly must have an IMPRINTPluginAttribute defined.
- The plugin class in the assembly must implement two interfaces in code: IExternalVariableProvider and IImprintPlugin.

- Any class that will be added by the plugin must have a default constructor.
- The .dll file must be in the IMPRINT Pro directory.

Creating an IMPRINT Pro Plug-In

To create an IMPRINT Pro Plug-in:

1. Start Visual Studio, and click New and then Project from the File menu.
2. On the New Project page, select Class Library from the Templates panel.
3. Name your project, and then click OK.
The Visual Studio Environment displays.
Setting Up the Project

To set up the project:

1. Delete the file Class1.cs from the Solution Explorer tree.

2. Select the project node in the tree, right-click and then click Add > Existing Item.
3. Select the two source-files `Plugin.cs` and `SampleClass.cs` (included with IMPRINT Pro):
   - **Plugin.cs**. This file allows IMPRINT Pro to recognize the files you have created in Visual Studio as plugins.
   - **SampleClass.cs**. This file is a sample class template for creating IMPRINT Pro plugins.

4. Click **OK**

5. Right-click the **References** node, and select **Add Reference**.

6. Select the **Browse** tab, and navigate to the IMPRINT Pro directory.

7. Select the file `MAAD.Plugins.ImprintPluginLoader.dll`, and click **OK**.
Writing the Code for Plugins

To write the code:

1. Rename `SampleClass.cs` and the `SampleClass` class as desired.
Double-click the class in the tree to open up its page. Rename in the Public Class line as well.

2. Write any desired functionality into the class; anything declared public will be accessible from IMPRINT Pro.

3. Open the Plugin.cs file.
4. In the IIMPRINTPlugin section of `Plugin.cs`, change the return values of the plugin's properties as desired.

```csharp
namespace Sample
{
    // <summary>
    // This class implements the interfaces necessary for integration into IMPRINT Pro. The
    // GetExternalVariables() method controls which classes will be loaded by this plugin.
    // </summary>
    public class Plugin : IExternalVariableProvider, IImprintPlugin
    {
        // The Name of this plugin.
        public string Name
        {
            get { return "Sample Plugin"; }
        }

        // The Author of this plugin.
        public string Author
        {
            get { return "Chris"; }
        }

        // The Date/Time this plugin was last modified.
        public DateTime Date
        {
            get { return DateTime.Today; }
        }

        // A Description of the plugin.
        public string Description
        {
            get { return "This is a sample plugin"; }
        }
    }
}
```

**Note:**
The Name, Author, Date and Description fields must all have properties in order for the plugin to work in IMPRINT Pro. You may enter null values if desired.
5. In the `IExternalVariableProvider` section, replace the name 'SampleClass' in the `typeof()` expression to the new name of the class.

```csharp
/// This class implements the interfaces necessary for integration into Imprint Pro. The
/// `GetExternalVariables()` method controls which classes will be loaded by this plugin.
/// <summary>
public class Plugin : IExternalVariableProvider, IImprintPlugin
{
    #region IExternalVariableProvider Members
    public IEnumerable<VariableName> GetExternalVariables()
    {
        List<VariableName> result = new List<VariableName>();

        // Fill the list with a VariableName object for each class that you want to expose to Imprint.
        result.Add(new VariableName(typeof(SampleClass)));

        // Alternatively, this line would add a "OldEMC" instance, but name it "EMC"
        result.Add(new VariableName("EMC", typeof(OldEMC)));

        return result;
    }

    #endregion

    #region IImprintPlugin Members
    [ImprintPlugin Member]
    /// If a plugin depends on other .dlls, their names need to be included here
    public string[] GetAssemblyReferences()
    {
        List<string> references = new List<string>();

        return references.ToArray();
    }

    #endregion
}
```

Use the following option for allowing the visible plugin to display as the name of its class:

```csharp
// Fill the list with a VariableName object for each class that you want to expose to Imprint.
result.Add(new VariableName(typeof(SampleClass)));
```

Use the following option for allowing the visible plugin to display as the name in quotes prior to the “typeof” designation:

```csharp
// Alternatively, this line would add a “OldEMC” instance, but name it “EMC”
result.Add(new VariableName("EMC", typeof(OldEMC)));
```

In the second example above, the plugin will appear in the Plugins list as “EMC.”
6. Further down in the `IMPRINT Pro Basic Procedures` section, set the assembly references and the namespace aliases. Together, these methods enable multiple .dll files to be called from within the same plugin.

- **Assembly Reference.** Used to tell IMPRINT Pro the name of any other .dll files where it must look. Any .dll that is referenced here must exist in the IMPRINT Pro base directory.

- **Namespace Alias.** Used to set the names of the namespaces in which it should look if multiple namespaces exist.

Both the Assembly References and the Namespace Aliases accept a string input, and in turn output an array of strings.

In the example below `Secondlibrary.dll` is added as an assembly reference while `SecondLibrary` is added as a namespace.

```csharp
// If a plugin depends on other .dlls, their names need to be included here
public string[] GetAssemblyReferences()
{
    List<string> references = new List<string>();
    references.Add("SecondLibrary.dll");
    return references.ToArray();
}

// If a plugin uses multiple namespaces, their names need to be included here
public string[] GetNamespacesAliases()
{
    List<string> namespaces = new List<string>();
    namespaces.Add("SecondLibrary");
    return namespaces.ToArray();
}
```

These methods must be defined in the Plugin class even if the plugin will not use any external references or namespaces. In that case, they should return empty string arrays.

- **Note:** Although this sample is written in C#, it is possible to write plugin code in any .NET language so long as it conforms to the restrictions above.
Building the Plugin

To build the plugin:

1. Right-click on the project node and select Build.

2. On the Build tab, set the Output path to the IMPRINT Pro directory.

3. Build the project.

4. Once your plugin is built, copy it into the IMPRINT Pro root directory. The next time you start up IMPRINT Pro, the plugin name will appear in the Output window in the list of loaded plugins.

Note:
For reasons of reference integrity and compatibility, user-created .dlls should reside in the IMPRINT Pro directory. It is important to pay careful attention if adding or deleting .dlls in this directory so as to avoid compromising existing IMPRINT Pro application files.

Displaying Plugins

Plugin .dll files you add to the IMPRINT Pro directory show up in the following two places in the IMPRINT Pro application window:

1. Output window. When you start up an IMPRINT Pro session, all plugins used by IMPRINT Pro display in text in the Output window. Any user-defined plugins appear in the second group of plugins listed.
2. **Analysis Tree.** The same user-defined plugins also appear under the Installed Plugins node in the tree.

*To View a List of Plugins in the Tree:*

Click the plus “+” sign next to the **Installed Plugins** node in the tree.

Any plugins added to the IMPRINT Pro directory appear as a list in the tree.

**Viewing the Parts of a Plugin in the Tree**

The IMPRINT Pro Analysis Tree displays the various levels of information comprising your plugin.

**Plugin Class**

The first level below the plugin node is the **Class** level.
To view the class level:

Click the plus “+” sign next to your plugin.

The Class level displays. All classes for the plugin display as a list and are accompanied by a red icon on the left.

In the example above, the plugin Sample Math contains a class called “ExtraMath”.

Plugin Methods and Plugin Properties

The second level of a plugin, just below the Class level, includes Methods and Properties of the plugin.

To view Methods and Properties:

Click the plus “+” sign next to the class in the tree.

The Methods and Properties of the plugin display.

- **Methods.** Methods appear in the tree with a purple icon. The name of the method is followed by a set of parameters enclosed in parentheses. These parameters are the types of values you would expect to provide as input to the plugin when called.
In the example above, the first method Cube expects a floating point, or Double, to be passed to it when the method is called whereas the second method Cube expects an integer. The third Cube method expects a string value which it will refer to as “s” within the plugin code itself.

- **Properties.** Properties appear in the tree with a green icon. The name of the property is followed by a set of parameters enclosed in parentheses. Depending on how the plugin is written, the parameters within the parentheses might indicate values which can be passed to a function (parentheses “( )”) or a value which you can expect to get but with no option to initially pass values to it first (square brackets “[ ]”).

In the example above, the property Pi returns a specific Double value when the plugin is called. No parameters can be passed to this property.

## Adding Hover Text to a Plugin

Hover text, also known as a “tooltip”, displays when hovering the mouse over a listed plugin in the tree. This text will only appear if it has been added by the plugin developer as an attribute of the plugin. If this attribute is attached to a Plugin Class, the text of the attribute will be displayed when you hover over that class’s tree node. If this attribute is attached to a Method or Property within the class, the text will be displayed when the you hover over the tree node corresponding to that Method or Property.

The following text is an example of code which can be added to a plugin to create hover text:

```csharp
using System;
using System.Collections.Generic;
using System.Text;
using System.ComponentModel;
using MAAD.Plugins.ImprintPluginLoader;
```
namespace MAAD.Plugins.ExtraMath
{
    [ToolTipText("This is the ExtraMath class of the Sample Plugin")]
    public class ExtraMath
    {
        [ToolTipText("The value of pi")]
        public double Pi
        {
            get { return Math.PI; }
        }

        [ToolTipText("Returns the Cube of the given floating-point number")]
        public double Cube(double number)
        {
            return number * number * number;
        }

        [ToolTipText("Returns the Cube of the given integer")]
        public int Cube(int number)
        {
            return number * number * number;
        }

        [ToolTipText("Nothing to see here...")]}
        public string Cube(string s)
        {
            string three = string.Join(" ", new string[]{s, s, s});
            string nine = string.Join(Environment.NewLine, new string[]{three, three, three});
            return nine;
        }
    }
}
Appendix A: Technical Description of Stressor Implementation

Evaluation of Human Performance under Diverse Conditions via Modeling Technology

Dr. Laurel Allender, Ms. Lucia Salvi, Dr. David Promisel

U.S. Army Research Laboratory Human Research and Engineering Directorate

Aberdeen Proving Ground, Maryland, U.S.A

Streamlined system acquisition and resource constraints are realities of military test and evaluation today. However, the pressure of saving time and dollars cannot be permitted to eliminate the assessment of total system performance - that is, the soldier, the hardware, and the software. Assessing combined soldier-system performance is as critical as ever. To address the challenges of the future battlefield requirements documents being written for military systems today regularly require operation in cold and hot conditions; in nuclear, biological, and chemical (NBC) environments; and over extended time periods. More and more functions are required to be automated, which does not necessarily make the job easier but, more likely, changes the nature of the job, the crew size, the task allocation, and the skills and abilities needed to do the job. These kinds of system requirements generate soldier-system dynamics that will affect overall system performance and must be evaluated throughout the system acquisition, design, and ultimately, the test and evaluation process.

In addition to the time and cost-effectiveness considerations that are givens for test and evaluation, regulations governing human use and test participant safety must also be considered. It is simply not permitted to test systems under all of the actual conditions in which they are required to operate. Certain hazardous conditions, for example, NBC operations, must be approximated. It is being proposed here that modeling not only provides a reasonable alternative for the approximation of performance under diverse--even extreme--conditions, but it also can be accomplished within the time and cost constraints. Existing data can be used to extrapolate to other conditions. Once a baseline model is built, excursions are typically straightforward. Modeling can be used iteratively to evaluate different conditions or to conduct sensitivity analyses and comparisons.
Over and above the ways in which modeling technology helps to address the time, cost, and safety concerns of test and evaluation, it offers a logical and sound approach to estimating human performance. It is a task-analytic approach that lends itself to good documentation and the building of audit trails. It can be used to help quantify what are, all too often, largely subjective assessments. It can also compensate for, or be used to extend operational field data that come with certain innate limits such as uncontrollable extraneous variables, small sample size, and non-repeatability. Modeling too, has its limitations; however, in combination with more traditional test and evaluation methods, for example, in a model-test-model mode, it can provide valuable estimates of human performance under a wide variety of conditions.

The IMPRINT Tool

The U.S. Army Research Laboratory Human Research and Engineering Directorate has developed a modeling and analysis tool, the Improved Performance Research Integration Tool (IMPRINT). The IMPRINT tool grew out of common U.S. Air Force, Navy, and Army manpower, personnel, and training (MPT) concerns identified in the mid-1970's: How to estimate MPT constraints and requirements early in system acquisition and how to enter those considerations into the design and decision-making process. The U.S. Navy first developed the HARDMAN (Hardware vs. Manpower) Comparability Methodology (HCM). The Army then tailored the manual HCM, which became known as HARDMAN I, for application to a broad range of weapon systems and later developed an automated version, HARDMAN II. In HARDMAN I and II, however, there was no direct link between MPT and performance. To directly remedy this shortcoming, the U.S. Army began the development of a set of software analysis modules in the mid-80's (Kaplan, 1988). This set of modules was called HARDMAN III, and although the name was the same, it used a fundamentally different approach for addressing MPT concerns than previous methods. It provided an explicit link between MPT variables and soldier-system performance. IMPRINT, while being an improvement over HARDMAN III, for the purpose of the discussion here, is essentially HARDMAN III in the Windows™ environment.

The mechanism for the MPT-performance link is task network modeling provided by the commercially-available Micro Saint task network simulation modeling engine, PC software designed for describing and analyzing task networks. The modeling capability offered can be further characterized based on three distinctions (Law & Kelton, 1991): (1) static vs. dynamic, (2) deterministic vs. stochastic, and (3) continuous vs. discrete. A static model does not address system effects over time,
whereas a dynamic model represents a system as it changes with time. A deterministic model does not represent any probabilistic, or random, elements. A stochastic model does encompass random elements and produces output that contains random error. A discrete model refers to instances where the variables characterizing the system change instantaneously at separated points in time. A continuous model is the converse, with variables that change continuously with time. In some instances, systems can be treated as either discrete or continuous, depending on the objectives of the analysis.

Using these definitions then, IMPRINT can be described as a dynamic, stochastic, discrete event modeling tool. When certain assumptions hold, namely, that the system of interest can be adequately described by task activities and networked sequencing, that dynamic processes and random variability are of interest, and that any continuous tasks can be fairly transformed into discrete tasks, then IMPRINT is an appropriate tool to use to represent and analyze soldier-system performance.

The basic modeling capability in IMPRINT requires the decomposition of a system mission into functions which, in turn, are decomposed into tasks. The functions are linked together into a network describing the flow of events. The network can include various types of branching logic such as parallel branches, probabilistic branches, and repeating branches. Within each function, the tasks are sequenced using the same types of branching logic options. At the task level, estimates of task performance time and accuracy means and standard deviations are input along with the consequences of the failure to perform a task accurately enough. The failure consequence options are no effect, total mission abort, repetition of
that or some other task, or subsequent degradation of some other task. The data entered are assumed to be representative of performance under "typical" or baseline conditions. Also, standards of performance can be entered to provide benchmarks for performance adequacy at the mission, function, and task levels. A sample IMPRINT screen depicting both the function and task level networks is shown in Figure 1.

IMPRINT executes a mission model task-by-task by first drawing a task time from the distribution as defined by the mean and standard deviation input for each task. (IMPRINT Pro assumes a default normal distribution although other distribution options are available). Then it calculates the probability of success for the task based on the accuracy inputs. Next it determines, for this instance, whether there is an accuracy failure. After checking for a given task, IMPRINT Pro proceeds through the task and function networks in accord with the established branching logic and analyzes the output according to the standards. When the model execution is completed (which can be anywhere from 1 to 999 repetitions), reports of estimated performance at each of the three levels are generated along with the comparisons to the standards. Although any given model and its associated assumptions must be scrutinized, this approach is particularly useful for comparisons across systems or system conditions.
Environmental Stressors in IMPRINT

Along with the basic task network simulation modeling capability, the IMPRINT tool includes specific algorithms or look-up tables—environmental stressors—to assess performance under diverse conditions. Recall that the task performance data entered in the baseline model are assumed to represent performance under “typical” conditions. The embedded environmental stressors automatically adjust performance to account for the changes expected under different levels of the stressors. Currently, IMPRINT includes five environmental stressors: protective clothing (that is, Mission-Oriented Protective Posture or MOPP), heat, cold, noise, and hours since last sleep (see Figure 2). The application of a stressor will result in either less accurate task performance, longer times to complete the task, or both. Stressors may be applied to an individual task or to all the tasks assigned to a particular job or Military Occupational Specialty (Specialty) for the mission. When the model is re-run, the new, or “stressed,” task performance time and/or accuracy are used as the task estimates that are “rolled up” in the task, function, and mission reports and compared against the standards. Importantly, the results can also be compared with the baseline model predictions. (See Dynamics Research Corporation, & Micro Analysis & Design, 1993) for more complete documentation.)
As a side note, IMPRINT also models the effects of two task performance shaping functions, based upon personnel characteristics and training frequency and recency. The personnel characteristics function uses both standardized Specialty entrance scores and the general Armed Forces Qualification Test (AFQT) scores. Different from the stressors, which only degrade performance, applying the performance shaping functions can result in either better or worse performance, depending on the level selected. For example, increasing the frequency of training results in improved performance, whereas decreasing the frequency lowers performance. IMPRINT also models the mental workload associated with task performance. Workload profiles can be developed for crew members, or, in the advanced mode, the interaction of workload and performance can be evaluated to include workload coping strategies and task-workload conflicts. Although these functions provide important analytic capabilities, the focus of the paper from this point is solely on the environmental stressors.

Before discussing each stressor in turn, it is important to note that not all tasks are affected in the same way or by the same stressor. To accommodate this, IMPRINT uses a task category weighting scheme. Nine categories or taxons used to describe a task (see Table 10-1) (Fleishman & Quaintance, 1984). Category weights are assigned to each task so that the various stressor effects are likewise weighted. In this way, each task contributes only the appropriate amount of change to the “stressed” performance at the mission level. Every task can be categorized with as many as three taxons. For example, operating a tractor and semi-trailer may involve driving a vehicle that is classified as “fine motor continuous” and may involve giving or receiving instructions, which is classified as “communication (oral).” Additionally, weights, which must sum to 1.0, are used to describe the degree to which a particular task manifests a particular taxon. In the example cited, operating a tractor and semi-trailer task might be composed of .75 fine motor continuous and .25 communication (oral). Modification of the taxon weights also allows for the consideration of new technology. For example, an automatic reloading device could change a heavy lifting or gross motor heavy task to a fine motor discrete task where only the manipulation of controls is required.
Table A-1: IMPRINT Taxons, Descriptions, and Task Examples

<table>
<thead>
<tr>
<th>Taxons</th>
<th>Definitions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>Requires using the eyes to identify or separate targets or objects</td>
<td>Seeing something move and then recognizing it as an enemy tank</td>
</tr>
<tr>
<td>Numerical</td>
<td>Requires performing arithmetical or mathematical calculations</td>
<td>Measuring an azimuth on a map with a protractor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Estimating the distance between two points on a map</td>
</tr>
<tr>
<td>Cognitive (Problem Solving and Decision Making)</td>
<td>Requires processing information mentally and reaching a conclusion</td>
<td>Locating a fault in an electrical system after troubleshooting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Selecting the best firing position for a machine gun</td>
</tr>
<tr>
<td>Fine Motor Discrete</td>
<td>Requires performing a set of distinct actions in a predetermined sequence mainly involving movement of the hands, arms, or feet with little physical effort</td>
<td>Assembly and disassembly of the M-16 rifle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Starting the engine of a truck</td>
</tr>
<tr>
<td>Fine Motor Continuous</td>
<td>Requires uninterrupted performance of an action needed to keep a system on a desired path or in a specific location</td>
<td>Driving a vehicle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tracking a moving target</td>
</tr>
<tr>
<td>Gross Motor Heavy</td>
<td>Requires expending extensive physical effort or exertion to perform an action</td>
<td>Lifting an artillery round</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Loosening a very tight bolt with a wrench</td>
</tr>
</tbody>
</table>
Table A-1: IMPRINT Taxons, Descriptions, and Task Examples (Cont.)

<table>
<thead>
<tr>
<th>Taxons</th>
<th>Definitions</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Motor Light</td>
<td>Requires moving the entire body (that is, not just the hands) to perform an action without expending extensive physical effort</td>
<td>Getting into a prone firing position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evacuating a tank</td>
</tr>
<tr>
<td>Communication (Read and Write)</td>
<td>Requires either reading text or numbers that are written somewhere or writing text or numbers that can be read</td>
<td>Reading a preventive maintenance check list for a vehicle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Writing a letter home</td>
</tr>
<tr>
<td>Communication (Oral)</td>
<td>Requires either talking or listening to another person</td>
<td>Giving a situation report by radio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Receiving a password from someone while on guard duty</td>
</tr>
</tbody>
</table>

Table 10-2 details which task taxons are affected by which stressors in the current IMPRINT software. It also shows whether the task performance is degraded by time, accuracy, or both. Since degradation factors are processed as multipliers, the degradation factors affecting time will be greater than 1.0 to increase the performance time. On the other hand, the degradation factors affecting accuracy will be less than 1.0 to decrease the performance accuracy from the pre-existing accuracy level. The overall degradation resulting from a specified stressor is directly proportional to the weighting assigned to the affected taxon(s) comprising the task.
Appendix A: Technical Description of Stressor Implementation

Table A-2: Listing of the IMPRINT Environmental Stressors and the Taxon Types Affected by Either Time or Accuracy or Both

<table>
<thead>
<tr>
<th>Taxon</th>
<th>MOPP</th>
<th>Heat</th>
<th>Cold</th>
<th>Noise</th>
<th>Sleepless Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>T</td>
<td>A</td>
<td>T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numerical</td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td>TA</td>
</tr>
<tr>
<td>Cognitive</td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td>TA</td>
</tr>
<tr>
<td>Fine Motor Discrete</td>
<td>T</td>
<td>A</td>
<td>T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine Motor Continuous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Motor Light</td>
<td>T</td>
<td></td>
<td>T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Motor Heavy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication (Read &amp; Write)</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication (Oral)</td>
<td>T</td>
<td>A</td>
<td>A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

where T = Affects task time only
A = Affects task accuracy only
TA= Affects task time and accuracy

**Effect of MOPP**

The effect of MOPP gear on task performance is modeled as a function of levels of MOPP gear and task taxon. As shown in Table 10-2, MOPP affects the time it takes to complete tasks described by the visual, fine motor discrete, gross motor light, and communication (oral) taxons. The degradation factors were derived from a series of studies conducted by the former Ballistic Research Laboratory (Wick, 1988) where the measure of performance degradation for each task was the time difference between performing the task in Battle Dress Uniform (BDU) and performing it in MOPP 4. Each task was later described in terms of ten human ability codes. These codes were mapped to the IMPRINT taxons and the degradation factor for each taxon was computed as the average of the mapped degradation factors by human ability code. MOPP level 0 is
equivalent to BDU and therefore has a degradation factor of 1 that correlates to “no degradation.” Degradation factors are applied as multipliers against the time that it takes to complete a task in BDUs. The most degraded performance is under MOPP 4 for fine motor discrete tasks and for oral communication tasks that take 1.7 times as long to perform. (The entire set of matrices of degradation factors for the stressors is not provided here but is available from the author on request.)

**Effect of Heat**

IMPRINT models the effects of heat on task performance accuracy as a function of dry bulb temperature and relative humidity using degradation factors based on various published reports and documents. Research relating heat stress to inaccurate performance (for example, Ramsey & Morrissey, 1978) was referenced. The MIL-HDBK-759-A (1981) was used to determine the effective temperature for different combinations of dry bulb temperature and relative humidity. And, data on the average number of mistakes per manhour as a function of effective temperature from the Bioastronautics Data Book (1981) were included in the derivation of the heat degradation factors. The derived factors applied solely to sedentary type tasks. Thus, the taxons affected are visual, numerical, cognitive, fine motor discrete, communication (read and write), and communication (oral). No degradation in accuracy performance is seen until the temperature reaches approximately 113°F (or 45°C) and the humidity reaches approximately 50%. Performance falls to essentially zero when the temperature reaches approximately 130°F (or 55°C) and the humidity reaches approximately 80%.

**Effect of Cold**

Cold weather degradation factors affecting task time performance are modeled in IMPRINT as a function of ambient temperature and wind velocity. Two functional relationships were developed from a study (Teichner, 1958) that related wind chill to percentage of performance loss. One relationship was developed for visual reaction time, thus providing the data for the visual and fine motor discrete taxons; the other was developed for manual skills, providing the data for the gross motor light taxon. The degradation factors for cold are computed as the percent loss of performance as a function of wind chill, wind chill being a function of wind
velocity and ambient temperature. Time effects range from a minimum of 1.03 times as long for temperatures of approximately 35° F (or 1° C) and a wind velocity of approximately 10 knots to a maximum of 1.70 times as long for temperatures of approximately -40° F (or -40° C) and a wind velocity of greater than 50 knots. Note that this degradation does not account for prolonged exposure to cold and wind.

**Effect of Noise**

The way in which IMPRINT models the effect of noise on task performance is based on the effectiveness of voice communications as a function of noise level and distance between the speaker and the listener. As shown in the Table 10-2, the degradation that results from various noise levels affects the accuracy with which a task that requires oral communications between two or more people is performed. The effect of noise on task accuracy and the resultant degradation factors were derived from a graph in MIL-STD-1472C. Distances modeled range from 1 to greater than 20 feet and noise levels range from 50 to greater than 110 dB PSIL. Approximately midway through the ranges modeled, accuracy of performance essentially drops to zero, as might be expected.

**Effect of Sleepless Hours**

In IMPRINT, sleepless hours refers to extended operations or the lack of sleep. It is important to note that sleep deprivation is the only environmental stressor that causes degradation in both the time to perform a task and the accuracy with which it is performed. IMPRINT models the stress of continuous operations as a function of hours since last sleep. Ranges of hours since last sleep go from 24 hours to greater than 96. At the 96-hour range, time to perform tasks is essentially doubled and accuracy has dropped to zero. The factors included in IMPRINT were derived from a review of several studies (Belenky et al., 1987), which found that the only taxons that are affected by lack of sleep are numerical and cognitive. Of note, in contrast to cognitive performance, physical strength and endurance are relatively unaffected by lack of sleep and can be restored by simple rest.
Multiple Taxons with Multiple Stressors

Many combinations of multiple stressors and taxons are also implemented in IMPRINT. Table 10-3 shows the possible combinations of stressors and the associated taxons. When two or more different stressors affect a task’s taxon in time or accuracy, the overall degradation is not just the sum of the individual degradations. In fact, the overall degradation is less than the sum of the individual degradations. As more stressors are added, they have less than the full effect on performance. Normally, the most severe stressor will have a full effect on performance. As additional stressors are added, they will have less and less impact on performance accuracy and time. This phenomenon is approximated with a power function (Harris 1985).

Table A-3: Possible Combinations of Stressors and Taxons Implemented in IMPRINT

<table>
<thead>
<tr>
<th>Stressors</th>
<th>Taxons</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOPP &amp; Heat</td>
<td>Visual</td>
</tr>
<tr>
<td></td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td></td>
<td>Communication (oral)</td>
</tr>
<tr>
<td>MOPP &amp; Cold</td>
<td>Visual</td>
</tr>
<tr>
<td></td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td></td>
<td>Gross Motor Light</td>
</tr>
<tr>
<td>MOPP &amp; Noise</td>
<td>Communication (oral)</td>
</tr>
<tr>
<td>Heat &amp; Noise</td>
<td>Communication (oral)</td>
</tr>
<tr>
<td>Heat &amp; Sleepless Hours</td>
<td>Numerical</td>
</tr>
<tr>
<td></td>
<td>Problem Solving</td>
</tr>
<tr>
<td>MOPP &amp; Heat &amp; Cold</td>
<td>Visual</td>
</tr>
<tr>
<td></td>
<td>Fine Motor Discrete</td>
</tr>
<tr>
<td>MOPP &amp; Heat &amp; Noise</td>
<td>Communication (oral)</td>
</tr>
</tbody>
</table>
IMPRINT Verification, Validation, and Accreditation (VV&A)

HARDMAN III, the IMPRINT predecessor was subjected to a formal VV&A process, the first of its type in the U.S. Army. The first phase, which is applicable here, comprised the core task network modeling capability and the effects implemented as additions to or modifications of the task data--mental workload estimation and environmental degradation, personnel characteristics, and training. A review board of representative users, policy-makers, technical experts, and soldier proponents evaluated the findings against eight criteria: configuration management, software verification, documentation, data input requirements, model granularity, validity of modeling techniques and embedded algorithms, output, and analysis timelines. All criteria were satisfied and formal accreditation was granted in January 1995 with only limited caveats (see Allender et. al, 1995).

Since the environmental stressors were transitioned to IMPRINT without modification, the basic VV&A transitioned as well. Of note, although this portion of the software was approved and the basic approach of degrading time and/or accuracy of performance on a task-by-task basis was supported, the consensus was that all the algorithms warrant updating and that new algorithms need to be developed to fill the voids. Referring to the Table 10-2, and to the dates of some of the environmental stressor references, it is clear that there are substantial voids and that there is certainly new research that should be accounted for in this arena.

Examples of the Method for Test and Evaluation

One example of the implications of this modeling approach to the test and evaluation arena was reported by Allender, McAnulty, and Bierbaum (1992). They describe the application of the predecessor HARDMAN III software to the analysis of potential options for reducing turnaround time in an Apache Forward Arming and Refueling Point (FARP). Once the baseline was constructed, three options were compared: adding a new equipment component, adding personnel, and changing reloading tactics, that is full vs. half reload of one ammunition type. The level of effort involved in the evaluation of options was only a fraction of the baseline
development costs and certainly only a fraction of comparable field trials. Since the modeling effort was conducted at the same time as the test planning was under way, the results were available to the test planners to help focus testing and to serve as a validation reference. They asserted that the results were appropriate to be used in interaction with testing, not as a substitute.

Another example is the work reported by McMahon, Spencer, and Thornton (1995). Within months of a final milestone review, an NBC reconnaissance system called the Fox had been given an “unacceptable” operational assessment at the completion of a large-scale field test. The central issue was that a four-seat vehicle had not been modified to fit the new three-person crew. The operator was forced to switch positions repeatedly in order to do the job, which caused safety problems and unacceptable performance. Coupled with modeling of proposed changes to the equipment and display layout, two mission models were built: the baseline and the proposed re-design. The mission model predicted substantially reduced workload and improved performance. Subsequently, the system was retro-fitted for a limited, two-week test which validated the model predictions. From this example the time, cost, and even safety benefits of using modeling in conjunction with testing are quite evident.

Proposed Environmental Stressor Developments

The examples provided in the previous section are good evidence for the utility of modeling in the test and evaluation arena; however, a comprehensive application of the environmental stressors for test and evaluation has not been completed. This is clearly a priority. Also, the shortcomings, voids, and need for updates to the stressors are obvious.

At this time, the literature in this area is being re-surveyed in order to develop a prioritized list of stressor updates, enhancements, and additions. Criteria for the prioritization are user need and availability of generalized data. Several other organizations have also identified this type of work as critical and plans for leveraging and cooperation are under way. Work of note includes that being performed under the auspices of the United Kingdom Defence Evaluation Research Agency Centre for Human Sciences, the Integrated Performance Modeling Environment. The U.S. Defense Special Weapons Agency (formerly the Defense Nuclear Agency) has published work in this area also (for example, Anno, Dore, & Roth, 1996). Close at hand, the U.S. Army Research Laboratory Human Research and Engineering Directorate is currently investigating databases on various dimensions of psychological stress as related to performance for inclusion in IMPRINT.
In conclusion, the IMPRINT tool offers a modeling technology for evaluating human performance under diverse conditions. Based on sound task analysis, network modeling, and environmental stressor degradation algorithms tailored to task type, assessments of performance under diverse conditions can be used to augment test and evaluation today. With continued development, the capability to perform these types of analyses will be further enhanced.

Acknowledgments

The contributions of the HARDMAN III and IMPRINT Verification and Validation Task Force, in particular Mr. Troy Kelley ARL HRED, were used in the preparation of this paper and are very much appreciated. The contributions of the IMPRINT contractors, Ms. Sue Archer and Ms. Patricia Kearns, Micro Analysis & Design and Mr. Rich Adkins, Dynamics Research Corporation were also relied upon heavily and likewise appreciated.

References


Appendix B: Human Performance Micromodels

IMPRINT Pro uses the following types of micromodels:

- Perceptual Micromodels
- Motor Micromodels
- Cognitive Micromodels
- Special Micromodels

Perceptual Micromodels

The following table contains the basic parameters for perceptual micromodels.

<table>
<thead>
<tr>
<th>Model</th>
<th>Value or Equation</th>
<th>Reference</th>
</tr>
</thead>
</table>
## Motor Micromodels

The following table contains the basic parameters for Motor micromodels.

<table>
<thead>
<tr>
<th>Model</th>
<th>Value or Equation</th>
<th>Reference</th>
</tr>
</thead>
</table>
| **Hand Movement (Fitt's Law-Welford Variant)** | $IM \log_2 [D/S + 0.5]$ where $T = \text{Movement Time}$  
  $D = \text{Distance between targets}$  
  $S = \text{Size of Targets}$  
  $IM = \text{Slope Constant} = .1 \text{ sec/bit}$ | Welford, 1968                                      |
## Appendix B: Human Performance Micromodels

### Hand Controls

<table>
<thead>
<tr>
<th>Model</th>
<th>Value or Equation</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cursor Movement with Trackball</td>
<td>$IM \times \log_2 (d/s + 0.5)$ where $IM = constant = 100$ msec/bit $d = cursor$ distance to be moved $s = display$ symbol width</td>
<td>Harris, R. M., Iavecchia, H. P., and Bittner, A. C., Jr. The HOS Micromodels. Proceedings of the Human Factors Society 32nd Annual Meeting, 1988, pp. 1051-1055., 1988 from Fitt’s Law.</td>
</tr>
<tr>
<td>Model</td>
<td>Value or Equation</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cursor Movement with Mouse</td>
<td>$1.03 + .06 \log_2 (D/S + .5) \text{ sec}$</td>
<td>Card, S. K., Moran, T. P., and Newell, A. The Psychology of Human-Computer Interaction. Erlbaum Associates Pub., 1983. Includes time for the hand to initially adjust its grasp on the mouse and time to make the selection with the mouse button.</td>
</tr>
<tr>
<td>Cursor Movement with Joystick</td>
<td>$KD + .100 \log_2 (D/S + .5) \text{ sec}$ where $KD = \text{intercept distance for distance } D$</td>
<td>Card et al., 1983</td>
</tr>
<tr>
<td>Cursor Movement with Step Keys</td>
<td>$98 + .074 \left( \frac{D_x}{S_x} + \frac{D_y}{S_y} \right) \text{ sec}$, where $D_x = \text{Horizontal distance to target}$</td>
<td>Card, S. K., Moran, T. P., and Newell, A. The Psychology of Human-Computer Interaction. Erlbaum Associates Pub., 1983.</td>
</tr>
<tr>
<td></td>
<td>$D_y = \text{Vertical distance to target}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$S_x = \text{Size of a vertical step (default } = .456 \text{ cm)}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$S_y = \text{Size of a horizontal step (default } = .246 \text{ cm)}$.</td>
<td></td>
</tr>
<tr>
<td>Model</td>
<td>Value or Equation</td>
<td>Reference</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cursor Movement using Text Keys</td>
<td>$0.66 + 0.209 \ N_{\text{min}} \text{ sec}$ where $0.209 = \text{Keystroke rate (in sec/keystroke)}$ which approximates the typing rate for random words $N_{\text{min}} = \text{minimum number of keystrokes}$.</td>
<td>Card, S. K., Moran, T. P., and Newell, A. The Psychology of Human-Computer Interaction. Erlbaum Associates Pub., 1983.</td>
</tr>
<tr>
<td>Single Finger Keying Rate</td>
<td>$0.140\ [0.060 = 0.200] \text{ sec}$</td>
<td>Card, S. K., Moran, T. P., and Newell, A. The Psychology of Human-Computer Interaction. Erlbaum Associates Pub., 1983.</td>
</tr>
</tbody>
</table>
### Cognitive Micromodels

The following table contains the basic parameters for cognitive micromodels.

<table>
<thead>
<tr>
<th>Model</th>
<th>Value or Equation</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Value or Equation</td>
<td>Reference</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Choice Reaction Time</td>
<td>$K \times \log_2 (n+1)$ where $K$ is a constant representing simple RT and is set at 150 msec. $n$ is number of possible alternatives</td>
<td>Hick’s Law as discussed in Card, S. K., Moran, T. P., and Newell, A. The Psychology of Human-Computer Interaction. Erlbaum Associates Pub., 1983.</td>
</tr>
<tr>
<td>Mental Rotation (Visualization)</td>
<td>$1 \text{ sec} + (R / 50^\circ \text{ per sec})$ where: $R =$ amount of rotation from initial perceived view to final visualized view (in degrees)</td>
<td>Shepherd and Metzler, 1971</td>
</tr>
</tbody>
</table>
## Special Micromodels

The following table contains the basic parameters for special micromodels.

<table>
<thead>
<tr>
<th>Model</th>
<th>Value or Equation</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prioritization (that is, of targets)</td>
<td>$0.310[n(n+1) / 2]$ where: $n = $ number of targets in a sector. This formula treats prioritization as a unidimensional [worth] pairwise comparison between all possible targets in a sector.</td>
<td>McCarthy, J., and Plocher, T. (Unpublished data), February 1990. Treats prioritization as a unidimensional pairwise comparison between all possible targets.</td>
</tr>
</tbody>
</table>
Index

A

abort mission ............................ 356
accuracy algorithms for stressors .......................... 433, 444
accuracy calculator
  accuracy measure ........................ 26
  mean .................................. 26
  overview ............................... 26
  standard deviation .................... 26
accuracy criterion .......................... 111
accuracy equations for stressors .......................... 433, 444
accuracy for stressors .......................... 432, 444
accuracy measure .......................... 26
accuracy measure, definition ......................... 553
accuracy requirement, definition ....................... 553
accuracy standard deviation, definition ................ 553
activities trump matrix
  changing .................................. 473
  displaying ................................ 473
  overview ................................. 472
activities trump matrix, definition .................... 553
adding
  analyses .................................. 7
  charts .................................. 231
  comments ................................. 245
  comments to goals ........................ 180
  comments to subnetworks ................. 122
  components ................................ 349
  cultural templates ......................... 240
  custom training moderator ................. 440
  external events .......................... 226
  force activities .......................... 462
  force jobs ................................ 475
  force schedules .......................... 459
  functions ................................ 116
  functions to goals ........................ 179
  functions to subnetworks .................. 121
  goals ................................... 173
  macros .................................. 206
  missions ................................ 109
  network objects .......................... 88
  nodes to subnetworks ...................... 131
  parameters to cultural templates ........... 243
  planned force activities to a schedule ........ 464
  repair tasks .............................. 351
  RI pairs ................................ 197
  RI resources ............................. 196
  scenarios ............................... 367
  scheduled functions ....................... 123
  segments ................................ 378
  snapshots ................................ 220
  stressors ................................ 428
  subsystems ................................ 347
  tasks to goals ............................ 179
  tasks to network diagrams ................. 135
  tasks to subnetworks ....................... 121
  units to forces ........................... 456
  unplanned force activity ................... 469
  variables ................................ 213
  variables to comments ..................... 246
  warfighters ................................ 68
  watches .................................. 291
adding functions
  MMF Template ............................. 267
adding missions
  MMF Template ............................. 265
adding tasks
  MMF Template ............................. 270
adjust & repair ................................ 354
algorithms
  accuracy for stressors ....................... 433, 444
  time for stressors .......................... 433, 444
ammo supply tab ............................. 369
analyses
  adding .................................... 7
  adding from library ......................... 8
  close all except current .................... 15
  close all in folder ......................... 15
  closing .................................. 14
  copying .................................. 16
  cutting .................................. 17
  defined ................................... 1
  deleting .................................. 17
  deleting folders .......................... 20, 21
  displaying information ....................... 13
  exporting ................................ 18
  exporting all in folder ...................... 19
  importing ................................ 10
  maintenance ............................... 1
  opening .................................. 12
  operations ................................ 1
  overview .................................. 1, 53
  pasting .................................. 16
  pasting network objects to .................. 100
  renaming folders .......................... 20
  saving .................................... 13
analysis description, definition ..................... 553
analysis name, definition ......................... 553
analysis tree
  adding folders ............................ 20
  deleting folders .......................... 21
  renaming folders .......................... 20
  window .................................. 33
analysis version, definition ....................... 554
Index

Animator .......................... 34

Animator window
  information displayed .............. 284, 391
  workload values .................... 284, 391

appearance of functions on network .... 120
appearance of scheduled functions on network 128

appearance time for external events ........ 228

applying custom training moderators : 450, 452

applying stressors .................... 439

armaments .......................... 346

array, definition ..................... 554
arrays
  example .......................... 215
  macros ............................ 208

auditory resources .................... 60

auditory task demand ................... 188

automatic mode for RI pair conflicts ...... 200

automatic task demand values ............ 186

availability, spare parts ............... 371

B

beginning effect ....................... 145
beginning effect, definition .......... 554

boolean variables ..................... 214

built-in macros, overview .............. 60

C

C# reserved variable names .............. 213
cancellation time ....................... 379
CC ................................... 357
changing
  activities trump matrix .............. 473
  appearance of functions on network .... 120
  appearance of scheduled functions on network .... 128
  levels in network diagram ............. 96
channel conflict report ............... 320
channels
  auditory .......................... 188
  automatic values .................... 186
  motor ................................ 190, 192
  RI .................................. 197
  speech .............................. 191
  visual ................................ 193
chart, workload graph data report ........ 334
charts
  adding ............................. 231
  copying ............................ 239
  creating a series .................. 235
cutting ............................... 239
deleting .............................. 240
displaying ............................ 232
displaying a list ...................... 231
displaying properties ................. 233
overview ............................. 230
pasting ............................... 239

tools ................................. 237

tools checking for syntax errors ........ 296, 398
clearing output window ................. 289, 395
clock system variables ................. 218
clock, definition ...................... 554
close all analyses in folder .......... 15
close all analysis except current ....... 15
closing
  analyses ........................... 14

code for macros ....................... 208
cognitive resources .................... 60
cognitive taxon ....................... 149

colors in event queue window .......... 289

combat damage potential .............. 62
combat damage report ................. 418
combat damage tab ..................... 383
comments
  adding ............................. 245
  adding to goals ..................... 160
  adding to subnetworks ............... 122
  adding variables .................... 246
  deleting ............................ 247
  displaying text ...................... 246
  editing ............................. 247
  overview ............................ 245

communication taxon .................... 149
components
  adding ............................. 349
  copying ............................ 350
cutting ............................... 349
deleting ............................... 349
displaying ............................. 348
displaying component information ........ 350
overview ............................. 348
pasting ............................... 350

conflict value ........................ 321
conflicts for RI pairs ................. 198
consumables tab ....................... 384
contact team
  adjust & repair ...................... 356
  travel time tab ...................... 371
contact team hit matrix summary report ..... 409
contact team tab ....................... 374
contingency operator ................... 148
contingency operators, definition ........ 554

copying
  analyses ........................... 16

452

538
charts .............................................. 239
components ....................................... 350
cultural templates ................................ 243
external events .................................... 229
functions .......................................... 118
goals ................................................ 177
macros ............................................. 210
missions .......................................... 103, 113
network diagram as image .................... 103
network objects .................................. 98
network text ...................................... 98
repair tasks ....................................... 357
scenarios .......................................... 375
scheduled functions ............................. 127
segments .......................................... 386
selected trace data ............................... 288, 394
stressors ......................................... 429, 442
subsystems ....................................... 347
tasks ................................................ 164
trace data to clipboard ........................ 288, 394
variables .......................................... 216
warfighters ........................................ 81

corrective maintenance type .................. 354
creating
  network diagram ................................ 86
  plugins ......................................... 498
  plugins for IMPRINT Pro ..................... 498
  RI pairs ........................................ 198
Creating Plugins ............................... 498
crew chief ........................................ 357
crew chief hit matrix report .................. 410
crew limits on .................................. 389
crew ratio, definition ........................... 554
crew tab .......................................... 148
  assignment contingency ...................... 148
  assignment primary ........................... 148
  warfighter ..................................... 148
crews
  assignment ..................................... 148
  maintenance ................................... 372
  warfighters ................................... 148
crewstation ...................................... 60
criterion, definition ............................ 554
criterions
  accuracy ....................................... 111
  functions ...................................... 116
  goals .......................................... 175
  mission ........................................ 112
  scheduled functions ......................... 124
time ............................................. 111
Cross Analysis Report ......................... 338
CT .................................................. 356
cultural events .................................. 62
cultural modeling
operations models ............................. 281
overview ......................................... 281
cultural templates
  adding .......................................... 240
  adding parameters ............................ 243
  copying ........................................ 243
  cutting ........................................ 244
  deleting ....................................... 244
  displaying ..................................... 241
  displaying properties ....................... 242
  overview ...................................... 240
  pasting ........................................ 244

custom macros .................................. 60

custom performance moderators
  overview ....................................... 64, 427

custom training moderator
  adding .......................................... 440

custom training moderators
  applying ....................................... 450, 452
  displaying ..................................... 440

cutting .......................................... 429, 441
  analyses ....................................... 429, 441
  charts ......................................... 239
  components ................................... 349
  cultural templates ........................... 244
  external events ............................... 229
  functions ..................................... 119, 127
  goals .......................................... 178
  macros ........................................ 210
  missions ....................................... 113
  network objects ............................... 98
  network text ................................... 98
  repair tasks ................................... 357
  scenarios ...................................... 376
  segments ...................................... 386
  stressors ...................................... 429, 441
  subsystems .................................... 347
  tasks .......................................... 165
  variables ...................................... 217
  warfighters ................................... 81

dailymaintenance report ....................... 404
daily reliability report ....................... 411
decision code ................................... 160
decision node, definition ..................... 555
decision type, definition ..................... 555
decision types
  multiple ....................................... 158
  probabilistic .................................. 159
  tactical ........................................ 159
default operator ................................ 73
Index

default strategy .......................... 75
deleting
analyses .................................. 17
collecting .................................. 240
comments .................................. 247
components ................................ 349
cultural templates ......................... 244
external events ............................ 230
folders in analysis tree .................... 20, 21
force schedules ............................ 460
functions .................................. 118
goals ........................................ 177
macro parameters .......................... 209
macros ...................................... 211
missions .................................... 112
network objects ............................. 93, 99
network text ................................. 99
paths from network diagram ................ 95
planned force activity ....................... 464
repair tasks ................................. 359
scenarios ................................... 376
scheduled functions ......................... 126
segments .................................... 387
snapshots ................................... 224
stressors .................................... 429, 441
subsystems .................................. 348
tasks ......................................... 164
unplanned force activities .................. 472
variables .................................... 218
warfighters ................................... 80
watches ...................................... 293
deleting missions
MMF Template ............................... 267
demand values ............................... 162
dimensions, macros ......................... 208
display
search window .............................. 294, 396
displaying
activities trump matrix ...................... 473
analyses information ....................... 13
charts ........................................ 232
charts list .................................... 231
component information ..................... 350
components .................................. 348
cultural templates ......................... 241
custom training moderators ................. 440
defined variables .......................... 212
definitions ................................. 279, 388
deletion ........................................
deletion of
meta-models .................................. 244
database ...................................... 245
deleted ......................................... 247
definitions ....................................
distribution ................................... 555
distributions .................................. 139
drawing paths .................................. 94
DS organizational level ..................... 355
dummy nodes .................................. 166
E
editing
comments ..................................... 247
execution settings ......................... 280
external events ............................. 228
goals .......................................... 177
macros ....................................... 209
network text and objects ................... 97
snapshots .................................... 224
tasks .......................................... 164
variables ..................................... 216
watches ....................................... 293
Index

editing functions
  MMF Template ...................................... 268
editing missions
  MMF Template ...................................... 266
editing tasks
  MMF Template ...................................... 272
effect, definition .................................... 555
effects tab ............................................ 143
  beginning effect ................................... 145
  ending effects ..................................... 146
  interrupt strategy .................................. 144
  release condition .................................. 144
  task priority ...................................... 144
ending effect, definition ............................... 555
ending effects ........................................ 146
enter task demand value automatically ................. 162
entity variables ....................................... 214
equipment
  elements ............................................. 63
  group name ........................................ 346
  overview .......................................... 62
  scenarios ......................................... 63
  subsystem ........................................ 63
equipment types
  armaments ......................................... 346
  mobility .......................................... 346
  other ............................................. 346
error checking ........................................ 296, 398
ersrors
  logic ............................................... 296, 398
  syntax ............................................ 296, 398
estimated task accuracy, definition ..................... 556
estimated task time, definition ......................... 556
event queue window ................................... 38
  colors ............................................ 289
  overview ......................................... 289
event queue, definition ................................ 557
event, definition ..................................... 557
executing
  force analysis model ................................ 478
  maintenance model .................................. 389
  operations model .................................. 281
execution
  external events ..................................... 230
  viewing external events .............................. 290
  viewing operations model data ........................ 282, 390
execution settings
  displaying .......................................... 279, 388
  editing ............................................. 280
  force analysis model ................................ 477
  maintenance model .................................. 388
operations model ...................................... 280
properties ............................................ 280
workload strategies .................................... 281
execution speed
  options ............................................. 298, 400
  real time ......................................... 298, 400
  setting ............................................ 298, 400
export
  Generic Conversion Variable ........................ 11
exporting
  all analyses in folder ................................ 19
  analyses .......................................... 18
  snapshot results files ................................ 225
expression, definition .................................. 557
external event properties
  appearance time ..................................... 228
  function triggered .................................. 228
external events ........................................ 61
  adding ............................................. 226
  copying .......................................... 229
  cutting .......................................... 229
  defined .......................................... 226
  deleting .......................................... 230
  displaying ........................................ 227
  displaying properties ................................ 227
  editing ............................................ 228
  overview .......................................... 228
  pasting .......................................... 229
  properties ........................................ 228
  task triggered ..................................... 228
  viewing execution .................................. 230, 290

F

failure ................................................ 146
failure tab ............................................ 146
floating point variables ................................. 215
folders
  adding in analysis tree ............................... 20
  deleting in analysis tree ............................ 21
  renaming in analysis tree ............................ 20
force activities
  adding ............................................. 462
  adding to a schedule ................................ 464
  deleting planned activity ............................ 464
  displaying categories ................................ 461
  displaying planned activities ........................ 462
  displaying properties ................................ 463
  overview .......................................... 460
  removing scheduled activity .......................... 467
force analysis model
  executing .......................................... 478
  execution settings .................................. 477

541
## Index

- **running** ........................................... 477
- **force jobs**
  - adding .......................................... 475
  - displaying ..................................... 475
  - displaying properties ....................... 475
  - overview ...................................... 474
- **force model reports**
  - viewing ........................................ 479
- **force schedules**
  - adding .......................................... 459
  - deleting ....................................... 460
  - displaying ..................................... 459
  - overview ...................................... 457
- **force unit, definition** .......................... 557
- **forces**
  - activities ..................................... 460
  - activities trump matrix ...................... 472
  - adding units .................................. 456
  - displaying ..................................... 456
  - displaying unit properties .................. 457
  - jobs ............................................ 474
  - overview ...................................... 453, 456
  - planned activities ............................ 461
  - schedules
    - adding 457 .................................. 457
  - unplanned activities ......................... 468
- **fuel supply tab** ................................. 368
- **function criterion, definition** ................. 558
- **function name** .................................. 116
- **function performance report** .................. 308
- **function properties**
  - criterion ...................................... 116
  - editing ........................................ 117
  - function name .................................. 116
  - time requirement ............................... 116
  - window ......................................... 117, 125
- **function time requirement, definition** ....... 558
- **function triggered for external events** ....... 228
- **function, definition** ............................ 557
- **functions** .......................... 58
  - adding .......................................... 116
  - adding to goals ................................ 179
  - adding to subnetworks ........................ 121
  - changing appearance on network .............. 120
  - copying ........................................ 118
  - cutting ......................................... 119, 127
  - deleting ........................................ 118
  - displaying information ........................ 116
  - editing information ............................ 117
  - examples ....................................... 115
  - pasting ......................................... 119, 128
  - properties ..................................... 116
  - review .......................................... 183
  - task-based triggers ............................ 222
- **functions for task-based triggers** .............. 222
- **G**
  - Generic Conversion Variable ...................... 11
- **goal properties**
  - criterion ...................................... 175
  - displaying ..................................... 173
  - initiating condition ........................... 176
  - mission running ................................ 175
  - priority ........................................ 175
  - time requirement ................................ 175
- **goals** ............................................. 59
  - adding .......................................... 173
  - adding comments ................................ 180
  - adding functions ................................ 179
  - adding tasks .................................... 179
  - copying .......................................... 177
  - cutting .......................................... 178
  - deleting ........................................ 177
  - displaying properties .......................... 173
  - editing .......................................... 177
  - overview ....................................... 172
  - pasting .......................................... 178
  - reviewing ....................................... 181
- **GS organizational level** ......................... 355
- **H**
  - hashtable variable types ....................... 215
  - headcount frequencies report .................. 415
- **I**
  - importing
    - MMF Template data ................................ 277
  - importing analyses
    - previous IMPRINT versions ..................... 10
  - initiating condition ............................ 176
  - inspect .......................................... 354
  - integer variable types .......................... 215
  - interval snapshots ................................ 222
- **J**
  - job, definition ................................. 558
- **L**
  - length of run, definition ....................... 558
  - levels
    - adding to stressors ........................... 431, 443
Index

micromodels ........................................ 29
military operational specialties ................. 53
minimum number of systems, definition ........ 559
mission accuracy criterion, definition .......... 559
mission criterion .................................. 112
mission criterion, definition ..................... 559
mission description ................................ 111
mission description, definition ................. 560
mission execution ..................................
  pausing ........................................... 297
  resuming ......................................... 297
  setting speed ................................... 298
  starting ......................................... 297
  stepping through ................................ 297
  stopping ......................................... 297
mission information, displaying .................. 110
mission name ...................................... 560
mission performance report ....................... 304
Mission Performance Summary .................... 304
mission properties ................................
  accuracy criterion ............................... 111
  editing .......................................... 112
  mission criterion ............................... 112
  mission description ............................ 111
  mission name ................................... 111
  time criterion .................................. 111
  time requirement ................................ 111
mission results by histogram report ............ 307
Mission Results by Run ............................ 305
mission running, goals ............................ 175
mission time criterion ............................ 560
mission time drivers report ....................... 313
mission time requirement, definition ............ 560
missions .............................................
  adding ........................................... 109
  components ..................................... 115
  copying .......................................... 103, 113
  cutting .......................................... 113
  deleting ......................................... 112
  displaying ........................................ 107
  displaying information .......................... 110
  editing properties .............................. 112
  elements ........................................ 55
  functions ........................................ 115
  names ............................................ 109
  overview ........................................ 54, 106
  pasting .......................................... 114
  pasting network objects to ........................................ 100
  scheduled ....................................... 114
  selecting ........................................ 110
  subfunctions ..................................... 54
  tasks ............................................. 106
  workload ........................................ 106
adding functions .................................... 267
adding missions ..................................... 265
adding tasks ...................................... 270
deleting missions ................................... 267
editing functions ................................... 268
editing missions ................................... 266
editing tasks ...................................... 272
importing into IMPRINT Pro ....................... 277
importing UJTL tasks ............................... 272
menu bar ........................................... 259
saving template data ............................... 276
task properties ..................................... 271
title bar ........................................... 259
tool bar ............................................ 260
MMH/System, definition ........................... 560
mobility ............................................. 346
model system variable .............................. 218
motor channel, task demands ..................... 190, 192
motor taxon ....................................... 149
MOUBF ............................................. 356
moving network objects ........................... 93
MPT analysis ....................................... 53
MRT .................................................. 59
MTTR ............................................... 356, 389
multiple decision type .............................. 158
Multiple Resource Theory .......................... 59

N

network diagram ....................................
  adding comments ................................... 245
  adding tasks ..................................... 135
  appearance of functions ........................ 120
  appearance of scheduled functions ............ 128
  changing levels ................................... 96
  copying as image .................................. 103
  creating .......................................... 86
  displaying comment text ........................ 246
  displaying path logic .............................. 94
  drawing paths .................................... 94
  dummy nodes ..................................... 166
  information displayed ........................... 284
  moving down a level .............................. 96
  moving up a level ................................. 96
  network animation ............................... 284
  objects .......................................... 87
  panning .......................................... 95
  printing .......................................... 103
  removing paths ................................... 95
  subnetworks ...................................... 120, 129
  variables ........................................ 212
  window .......................................... 39
  zooming .......................................... 95

MMF Template

544
Index

objects to analysis ...................................... 100
objects to mission model ............................... 100
repair tasks .............................................. 358
scenarios ............................................... 376
scheduled functions ................................. 128
segments .............................................. 386
stressors ............................................. 430, 442
subsystems ........................................... 348
tasks .................................................. 165
variables ............................................... 217
warfighters ........................................... 82
path, definition ....................................... 561
paths ................................................... 58
deleting ............................................... 95
displaying logic ..................................... 94
drawing ............................................... 94
removing ........................................... 95
tab ...................................................... 157
paths tab ............................................... 157
decision code ....................................... 160
decision types ....................................... 158
pausing mission execution ......................... 297
pausing scenario execution ......................... 399
penalties ............................................... 72
accuracy ............................................. 72
time .................................................. 72
perceptual taxon .................................... 149
perfect accuracy ................................... 281
personnel analysis ................................ 53
personnel forecast report ......................... 335
Planned Activity, definition ......................... 562
planned force activities overview .................. 461
plugins .................................................
creating ............................................. 498
creating for IMPRINT Pro ......................... 498
overview ........................................... 65, 497
setting up project .................................. 500
using .................................................. 497
writing the code .................................. 502
preventive maintenance type ...................... 354
primary operator .................................. 148
primary operator, definition ...................... 562
Print Network ....................................... 104
Print Selected ....................................... 104
Print Visible ........................................ 104
printing ................................................
  network diagram ................................ 103
priority ............................................... 175
probability of success ............................. 141
probability of success, definition .......... 562
properties window ................................. 41
psychomotor resources ......................... 60
PTS adjustments ................................. 281, 389
random number seed .............................. 280, 389
random number seed, definition .............. 562
rank, definition .................................... 562
rejoining tasks .................................... 147
release condition .................................. 144
release condition, definition ...................... 562
release conditions ................................ 145
reliability and availability report ............ 405
reliability summary ............................... 405
remove & replace .................................. 354
removing scheduled force activity .......... 467
renaming ................................................
tab folders in analysis tree ...................... 20
macros .............................................. 207
repair tasks ...........................................
  adding ............................................. 351
copying ............................................. 357
cutting .............................................. 357
deleting ............................................. 359
displaying ........................................... 351
displaying data .................................... 353
maintenance action ................................ 358
overview ............................................ 351
pasting .............................................. 358
properties ........................................... 353
repeating segments, definition ............... 563
repeating snapshots .............................. 222
replacement systems, definition .............. 563
reports .............................................
  maintenance model results .................. 402
  operational results ......................... 301
  personnel forecast ......................... 335
reserved variable names ......................... 213
resource-interface channels, definition .... 563
results for snapshots ............................ 224
resuming mission execution .................... 297
resuming scenario execution .................... 399
return type, macros ............................. 208
review ................................................
  displaying ....................................... 181
  functions ....................................... 183
goals ................................................ 181
task demands ..................................... 186
task information ................................ 184
tasks ............................................... 184
  warfighters assignment ..................... 194
review tasks .........................................
Index

S

saving analyses 13
MMF Template data 276
trace data to a file 287, 393
scenario data
ammo supply tab 369
contact team tab 374
displaying 367
fuel supply tab 368
maintenance crew tab 372
segment tab 367
spares tab 371
time tab 370
scenario description, definition 563
scenario execution
pausing 399
resuming 399
setting speed 400
starting 399
stepping through 399
stopping 400
scenario name, definition 563
scenarios
adding 367
copying 375
cutting 376
deleting 376
displaying equipment 63
overview 365
pasting 376
segments 376
scenario data
scenario execution
scenario description, definition
scenario execution
scenario name, definition
scenarios
adding
copying
cutting
deleting
RI pairs
adding 197
adding resources 196
auditory 195
automatic mode for conflicts 200
cognitive 195
creating 198
defining conflicts 198
displaying channels 197
displaying interfaces 196
displaying resources 196
human resources 60
manual mode for conflicts 201
motor 195
MRT 59
overview 59, 195
speech 195
visual 195
role, definition 563
run number, definition 563
S

scheduled function name 124
scheduled function properties
criterion 124
editing 126
scheduled function name 124
time requirement 124
scheduled functions
adding 123
changing appearance on network 128
copying 127
deleting 126
displaying information 124
editing information 126
pasting 128
properties 124
Scheduled Missions 114
schedules
adding 459
deleting 460
searching
maintenance model 396
operations model 294
text 295, 397
seed, definition 563
segment cancellation time, definition 564
segment duration time, definition 564
segment info tab
cancellation time 379
number per departure group 380
segment priority 380
start day 379
start time 379
time between departures 380
segment priority, definition 564
segment repeat mean time, definition 564
segment start day, definition 564
segment start time, definition 565
segments
adding 378
combat damage tab 383
consumables tab 384
copying 386
cutting 386
deleting 387
displaying 377
displaying data 378
information 379
overview 376
pasting 386
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>segments tab, scenario data</td>
<td>367</td>
</tr>
<tr>
<td>selecting</td>
<td></td>
</tr>
<tr>
<td>missions</td>
<td>110</td>
</tr>
<tr>
<td>multiple items on network diagram</td>
<td>97</td>
</tr>
<tr>
<td>network objects</td>
<td>97</td>
</tr>
<tr>
<td>selecting network text and objects</td>
<td>97</td>
</tr>
<tr>
<td>series</td>
<td></td>
</tr>
<tr>
<td>charts</td>
<td>235</td>
</tr>
<tr>
<td>setting speed for real time simulation</td>
<td>298</td>
</tr>
<tr>
<td>shift data, definition</td>
<td>565</td>
</tr>
<tr>
<td>shift length, definition</td>
<td>565</td>
</tr>
<tr>
<td>shift manning</td>
<td>344</td>
</tr>
<tr>
<td>shifts per day, definition</td>
<td>565</td>
</tr>
<tr>
<td>show snapshot results</td>
<td>224</td>
</tr>
<tr>
<td>skill level</td>
<td>355</td>
</tr>
<tr>
<td>snapshot info tab</td>
<td></td>
</tr>
<tr>
<td>function</td>
<td>222</td>
</tr>
<tr>
<td>interval</td>
<td>222</td>
</tr>
<tr>
<td>is repeating</td>
<td>222</td>
</tr>
<tr>
<td>start time</td>
<td>222</td>
</tr>
<tr>
<td>stop</td>
<td>222</td>
</tr>
<tr>
<td>stop time</td>
<td>222</td>
</tr>
<tr>
<td>task</td>
<td>222</td>
</tr>
<tr>
<td>trigger type</td>
<td>222</td>
</tr>
<tr>
<td>snapshot properties</td>
<td></td>
</tr>
<tr>
<td>overview</td>
<td>221</td>
</tr>
<tr>
<td>snapshot info tab</td>
<td>222</td>
</tr>
<tr>
<td>snapshot results files</td>
<td></td>
</tr>
<tr>
<td>opening in Excel</td>
<td>226</td>
</tr>
<tr>
<td>showing</td>
<td>224</td>
</tr>
<tr>
<td>snapshot variables tab</td>
<td>223</td>
</tr>
<tr>
<td>snapshot, definition</td>
<td>565</td>
</tr>
<tr>
<td>snapshots</td>
<td>61</td>
</tr>
<tr>
<td>adding</td>
<td>220</td>
</tr>
<tr>
<td>deleting</td>
<td>224</td>
</tr>
<tr>
<td>displaying defined</td>
<td>220</td>
</tr>
<tr>
<td>displaying definitions</td>
<td>220</td>
</tr>
<tr>
<td>editing</td>
<td>224</td>
</tr>
<tr>
<td>exporting results files</td>
<td>225</td>
</tr>
<tr>
<td>overview</td>
<td>219</td>
</tr>
<tr>
<td>properties</td>
<td>221</td>
</tr>
<tr>
<td>results</td>
<td>224</td>
</tr>
<tr>
<td>specifying variables</td>
<td>223</td>
</tr>
<tr>
<td>spare availability</td>
<td>62</td>
</tr>
<tr>
<td>spares tab</td>
<td>371</td>
</tr>
<tr>
<td>specialties</td>
<td></td>
</tr>
<tr>
<td>changing for maintainers</td>
<td>79</td>
</tr>
<tr>
<td>changing for supply and support personnel</td>
<td>80</td>
</tr>
<tr>
<td>changing for warfighters</td>
<td>73</td>
</tr>
<tr>
<td>warfighters</td>
<td>53</td>
</tr>
<tr>
<td>specialty and skill level</td>
<td>355</td>
</tr>
<tr>
<td>specialty, definition</td>
<td>565</td>
</tr>
<tr>
<td>speech resources</td>
<td>60</td>
</tr>
<tr>
<td>speech task demand</td>
<td>191</td>
</tr>
<tr>
<td>spinner task, definition</td>
<td>565</td>
</tr>
<tr>
<td>standard deviation</td>
<td>26</td>
</tr>
<tr>
<td>start time, snapshots</td>
<td>222</td>
</tr>
<tr>
<td>starting mission execution</td>
<td>297</td>
</tr>
<tr>
<td>starting scenario execution</td>
<td>399</td>
</tr>
<tr>
<td>status bar</td>
<td>42</td>
</tr>
<tr>
<td>step chart, workload graph data report</td>
<td>334</td>
</tr>
<tr>
<td>stepping through mission execution</td>
<td>297</td>
</tr>
<tr>
<td>stepping through scenario execution</td>
<td>399</td>
</tr>
<tr>
<td>stop snapshot</td>
<td>222</td>
</tr>
<tr>
<td>stop time snapshot</td>
<td>222</td>
</tr>
<tr>
<td>stopping mission execution</td>
<td>298</td>
</tr>
<tr>
<td>stopping scenario execution</td>
<td>400</td>
</tr>
<tr>
<td>strategies</td>
<td></td>
</tr>
<tr>
<td>default</td>
<td>75</td>
</tr>
<tr>
<td>entering</td>
<td>75</td>
</tr>
<tr>
<td>Stressor Settings</td>
<td>326</td>
</tr>
<tr>
<td>stressors</td>
<td>429</td>
</tr>
<tr>
<td>accuracy</td>
<td>441</td>
</tr>
<tr>
<td>accuracy equations</td>
<td>433</td>
</tr>
<tr>
<td>adding</td>
<td>428</td>
</tr>
<tr>
<td>adding levels</td>
<td>431</td>
</tr>
<tr>
<td>applying</td>
<td>439</td>
</tr>
<tr>
<td>copying</td>
<td>429</td>
</tr>
<tr>
<td>creating accuracy algorithms</td>
<td>433</td>
</tr>
<tr>
<td>deleting</td>
<td>429</td>
</tr>
<tr>
<td>deleting levels</td>
<td>432</td>
</tr>
<tr>
<td>displaying</td>
<td>428</td>
</tr>
<tr>
<td>displaying</td>
<td>430</td>
</tr>
<tr>
<td>time</td>
<td>432</td>
</tr>
<tr>
<td>time snapshot</td>
<td>444</td>
</tr>
<tr>
<td>string variable types</td>
<td>215</td>
</tr>
<tr>
<td>subfunctions</td>
<td>54</td>
</tr>
<tr>
<td>subnetworks</td>
<td></td>
</tr>
<tr>
<td>adding comments</td>
<td>122</td>
</tr>
<tr>
<td>adding functions</td>
<td>121</td>
</tr>
<tr>
<td>adding nodes</td>
<td>131</td>
</tr>
<tr>
<td>adding tasks</td>
<td>121</td>
</tr>
<tr>
<td>displaying</td>
<td>120</td>
</tr>
<tr>
<td>overview</td>
<td>129</td>
</tr>
<tr>
<td>subsystem</td>
<td></td>
</tr>
<tr>
<td>information</td>
<td>346</td>
</tr>
<tr>
<td>overview</td>
<td>345</td>
</tr>
<tr>
<td>subsystem equipment name, definition</td>
<td>566</td>
</tr>
<tr>
<td>subsystem of equipment</td>
<td>63</td>
</tr>
<tr>
<td>subsystem, definition</td>
<td>347</td>
</tr>
<tr>
<td>subsystems</td>
<td></td>
</tr>
<tr>
<td>adding</td>
<td>347</td>
</tr>
<tr>
<td>copying</td>
<td>347</td>
</tr>
<tr>
<td>cutting</td>
<td>347</td>
</tr>
<tr>
<td>defined</td>
<td>345</td>
</tr>
<tr>
<td>deleting</td>
<td>348</td>
</tr>
<tr>
<td>displaying</td>
<td>345</td>
</tr>
<tr>
<td>overview</td>
<td>345</td>
</tr>
</tbody>
</table>
Index

pasting ........................................ 348
supply and support personnel
    changing specialties ................. 80
supply and support report ............ 412
supply personnel, warfighters ........ 79
support personnel, warfighters ....... 79
syntax errors .............................. 296, 398
syntax errors, checking ............... 296, 398
syntax helper .............................. 31, 32
system ..................................... 218
system variables
    clock .................................... 218
    model .................................. 218

T

tactical decision types ................. 159
task accuracy probability, definition ... 566
task criterion, definition ............. 566
task data mapping, warfighters ....... 101
task demands
    auditory channel ..................... 188
    automatic values .................... 186
    cognitive channel .................... 189
    motor channel ........................ 190, 192
    review tasks .......................... 186
    speech ................................ 191
    visual channel ......................... 193
task failure report ...................... 312
task information dialog box
    crew tab ................................ 148
    effects tab ............................ 143
    failure tab ............................ 146
    overview ................................ 136
    paths tab ................................ 157
    taxons tab ................................ 148
    timing and accuracy tab .............. 137
    workload demand tab .................. 160
task information, review tasks ......... 184
task mean accuracy, definition ....... 566
task name, definition .................... 567
task network
    cultural events ..................... 62
    elements .............................. 55
    external events ..................... 61
    functions ............................ 58
    goals .................................. 59
    macros .............................. 60
    paths .................................. 58
    RI pairs ................................ 59
    snapshots ............................. 61
    variables .............................. 61
task performance report .............. 309
task priority .............................. 144
task priority, definition .............. 567
task properties
    MMF Template ......................... 271
task standard deviation, definition ... 567
task time requirement, definition .... 567
task trace report ......................... 323
task triggered for external events .... 228
task, definition .......................... 566
task-based triggers ...................... 222
tasks
    adding to goals ....................... 179
    adding to network diagrams .......... 135
    adding to subnetworks ............... 121
    beginning effect ..................... 145
    copying .............................. 164
    cutting ............................... 165
    deleting .............................. 164
    displaying properties ............... 136
    editing ............................... 164
    ending effects ....................... 146
    examples ............................. 134
    failure ............................... 146
    interrupt strategy ................... 144
    overview ............................. 134
    pasting ............................... 165
    priority .............................. 144
    rejoining ............................ 147
    release condition .................... 144
    release conditions ................... 145
    reviewing ............................ 184
    task information dialog box ....... 136
    task-based triggers ................... 222
taxons
    cognitive ............................. 149
    communication ....................... 149
    motor .................................. 149
    perceptual ............................ 149
taxons tab ............................... 148
test & check ............................. 354
text
    copying ............................... 98
    cutting ............................... 98
    deleting .............................. 99
    pasting ............................... 99
    searching ............................ 295, 397
    selecting ............................ 97
time between departures, definition ... 567
time criterion ........................... 111
time for stressors ....................... 432, 444
time format, definition ............... 568
time requirement
    functions ............................ 116
    goals ................................. 175
missions .................................. 111
scheduled functions ..................... 124
time requirement, definition .......... 568
timing and accuracy tab ................ 137
accuracy measure ........................ 137
accuracy requirement ................... 137
accuracy standard deviation .......... 140
criterion ................................ 138
distribution ................................ 139
mean accuracy .......................... 140, 559
probability of success ................. 141
time requirement ........................ 137
title bar .................................. 24
toolbar .................................... 24, 260
tools
  charts .................................. 237
trace data
  copying selected output .......... 288, 394
  copying to clipboard ............... 288, 394
  displaying ........................... 286, 392
  saving to file ......................... 287, 393
trace of execution ...................... 39
training analysis ...................... 53
training frequency .................... 389
travel time ................................ 371
travel time tab .......................... 370
trigger types
  begin task ............................ 222
  clock .................................. 222
  end of run ............................ 222
  end task ................................ 222
trigger types, snapshots .............. 222
troubleshoot ........................... 354

U

UJTL tasks
  importing into the MMF Template ... 272
Universal Joint Task List ............ 272
unplanned activity, definition ...... 568
unplanned force activities
  adding .................................. 469
deleting .................................. 472
displaying properties ................ 469
overview .................................. 468
viewing .................................. 468

V

variable names .......................... 213
variable properties
  array .................................. 215
cultural .................................. 216
initial value ............................ 216
type .................................... 214
variable types
  boolean .................................. 214
data type .................................. 214
  entity .................................. 214
  floating point .......................... 215
  hashtable ................................ 215
  integer .................................. 215
  object .................................. 215
  string .................................. 215
  void ................................... 215
variable watches window ............. 41
adding watches .......................... 291
deleting watches .......................... 293
editing watches .......................... 293
overview .................................. 291
variable, definition .................. 568
variables .................................. 218
adding ................................... 213
adding to comments .................... 246
clock .................................... 61
copying .................................. 216
cutting .................................. 217
default .................................. 61
deleting .................................. 218
displaying defined ...................... 212
displaying descriptions ............... 214
deriving .................................. 216
model .................................. 61
overview .................................. 61, 212
pasting .................................. 217
properties ................................ 214
reserved names ........................ 213
snapshot .................................. 223
task .................................... 61
visual resources .......................... 60
visual task demand ..................... 193
void variable type ..................... 215

W

Warfighter Data .......................... 67
warfighter, definition ................. 568
warfighters
  accuracy penalty ...................... 72
  adding .................................. 68
  automated ................................ 72
  changing specialties .................. 73
  copying .................................. 81
  crew maintainer ....................... 73
crew tab .................................. 148
cutting .................................. 81
default management strategy ........ 75
default strategy .................. 72
defined .......................... 54
deleting .......................... 80
displaying ........................ 67
displaying maintainers .......... 78
displaying properties .......... 71
displaying supply personnel .. 79
displaying support personnel .. 79
elements .......................... 54
flow model ........................ 53
maintainers ....................... 67
mapping .......................... 101
name ............................. 71
operators .......................... 67
overview .......................... 53
pasting .......................... 82
personnel characteristics ..... 53
properties ........................ 67, 71
specialties ....................... 53
specialty ......................... 72
supply and support ............. 67
threshold ......................... 72
time penalty ...................... 72
workload management strategies . 74
watches
  adding .......................... 291
deleting .......................... 293
  editing .......................... 293
windows
  analysis tree .................... 33
  event queue ..................... 38
  network diagram ................ 39
  output .......................... 39
  palette .......................... 40
  properties ........................ 41
  variable watches ................ 41
  windows pane .................... 40
windows pane ..................... 40
workload
  entering demand values ........ 160
  mission component ............ 106
taxons .......................... 148
warfighters ....................... 107
workload demand tab ........... 162
demand values ................... 162
overview ........................ 160
workload demand values ........ 162
workload graph data report ..... 334
workload management
  strategies ........................ 74
warfighters ....................... 74
workload strategies ............. 281
Glossary

A

**Accuracy Measure**
Accuracy Measure is a unit corresponding to the nature of how your task’s accuracy is measured. This unit helps IMPRINT Pro to determine whether your task is more or less accurate when the number pulled from the accuracy distribution is greater or less than the requirement you set. For example, assume that your Accuracy Measure is set to Percent Steps Correct and your Accuracy Requirement is set to 80. If the number pulled from the Accuracy distribution is 85, then IMPRINT Pro will consider this accuracy value to be a success since 85% is better than 80% in the context of Percentage of Steps Correct. If, however, you intend to choose the unit of Measure Feet from Desired, IMPRINT Pro will consider this accuracy value of 85 to be a failure since 85 is less accurate than 80 in the context of Feet from Desired.

**Accuracy Requirement**
The Accuracy Requirement is the minimum acceptable accuracy for a task in order for it to be considered a success.

**Accuracy Standard Deviation**
The Accuracy Standard Deviation specifies how tightly all the various values in the distribution are clustered around the Mean Accuracy value.

**Activities Trump Matrix**
A matrix used to set task priority within a Force Unit schedule for when any two activities overlap.

**Analysis Description**
A brief description of the analysis found in the Properties window. The Analysis Description is optional.

**Analysis Name**
The Analysis Name can be 20 characters long and can include spaces and symbols. When an analysis is added, IMPRINT Pro automatically generates an analysis name that the user may edit in the Properties window. However, when an analysis is saved, the user will need to enter a name in the dialog provided.
**Analysis Version**

The Analysis Version can be 20 characters long and can include spaces and symbols. When an analysis is added, IMPRINT Pro automatically generates an analysis version that the user may edit in the Properties window. When an analysis is saved, the user will need to enter a version number in the dialog provided.

**Array**

An ordered set of variable values that are indexed to a single variable name. An array can be a one-dimensional list, a two-dimensional table of rows and columns, or a multi-dimensional array.

**Beginning Effect**

An expression used to change the values of variables in the model as a result of a task starting.

**Clock**

System variable that records elapsed time in simulation time units since the beginning of model execution. The Clock variable can be used in any expression in a model.

**Contingency Operators**

One or more contingency operators may be selected for each task. During the task reallocation process, a contingency operators will be considered if workload overload occurs during mission execution.

**Crew Ratio**

Crew Ratio is the average number of crews available for each new system in the unit. In some cases where systems are required to operate continuously there may be multiple crews for each system.

**Criterion**

This value is the percentage of time that this task, function or mission must meet both its time requirement and its accuracy requirement simultaneously in order to be considered successful.
Glossary

D

Decision Node
A diamond-shaped object on a network diagram containing one of the following letters: P, M, or T—representing a Probabilistic, Multiple, or Tactical decision.

Decision Type
The Decision Type determines which path(s) an entity may follow when exiting a node which branches out along multiple paths. Tasks with a decision type of Multiple will follow all paths every time; tasks with a decision type of Probabilistic are likely to follow the path(s) in proportion to the percentages you set for each path; tasks with a decision type of Tactical will follow only those paths whose conditions evaluate to True; tasks with a decision type of Single will only ever follow one path.

Distribution
The range of all possible values which can be assigned to a task’s time value and the probability that those values will be chosen at random.

E

Effect
An expression that executes as a result of task activity during model execution. Tasks can have beginning, and ending effects. You can use these effects to change variable values and thus represent the system changes that occur as a result of the task activity.

Ending Effect
An expression used to change the values of variables in the model because of a task ending.

Entity
A conceptual object that travels through a task network and indicates by its location when each task is executing or waiting to execute. The entity may represent a physical object, such as a part being built on a production line. It may also represent a person performing the tasks. Or, the entity may simply trace the sequence of tasks and not correspond to anything physical. During model execution, entities can be represented by symbols or numbers that travel through the network diagram. Entities are identified by corresponding values of their entity attributes.
**Entity.Duration**
An Entity attribute that records the time each entity spends in the current task.

**Entity.Tag**
An Entity attribute that records the identity of each entity when there are multiple entities traveling through a network. Once an entity has an Entity.Tag value, the value stays with the entity through the remainder of model execution.

**Estimated Task Accuracy**
Use Task Mean Accuracy and Accuracy Standard Deviation under this section of the TimeAcc tab to specify an average value for how accurately a particular task is likely to be performed. For example, you might say that on the average when performing this task the operators get 90 percent of the steps correct or for another tasks they are within 10 mils of the correct azimuth. Under the first option, you will also specify the standard deviation, which in some sense is a measure of the worst and best the task is likely to be performed. An easy rule of thumb for specifying the standard deviation is to compute the difference between the worst and best performance and divide it by 6. For example, if the worst performance is 40% steps correct and the best is 100%, then an estimate for the standard deviation would be 10% \(((100 - 40)/6) = 10\). Under this option you will define what is acceptable performance by specifying an accuracy standard. For example, you may say that any error greater 5 mils causes firing inaccuracies that are unacceptable. With the information above, the model then computes the probability of the task performance being at or above the standard and compares a selected random number to determine if task was performed accurately.

**Estimated Task Time**
The Estimated Task Time is the amount of time a task will take to execute as calculated by IMPRINT Pro. This time will vary each time the task is executed. To calculate this time, IMPRINT Pro starts with an initial task time which can either be represented as a value (entered in the Value field in the format of HH:MM:SS.mm) or as a time expression (entered in the Expression field and evaluated to seconds). Next, IMPRINT Pro pairs this initial time with a statistical distribution type. This distribution determines the possible values your task time could take relative to your initial value. When IMPRINT Pro runs, a random number is generated and is used to pull a number from the distribution you have specified. This number
becomes the Estimated Task Time for that occurrence of the task. Note: of
the available 20 distribution types, IMPRINT Pro uses, by default, the
Normal distribution which uses Mean and Standard Deviation to predict a
task performance time. Depending on the distribution type you choose to
use, different and/or additional parameters such as Shape, Probability of
Success, Maximum, Minimum and Scale, might also be required.

**Event**

Something that is scheduled to happen during a simulation at a specific
clock time. Some events are expressions that you schedule to occur at
specific times—these are called scenario events. All other events are
scheduled, such as the finish times for currently executing tasks, as the
model is running. You can watch events being scheduled by displaying the
Event Queue window.

**Event Queue**

Events that are scheduled to happen during model execution are placed in
an Event Queue. As each event occurs, it is removed from the top of the
queue. These events are displayed in the Event Queue window.

**Expression**

A calculation, formula, macro, or statement that supplies a value or
performs an operation. Expressions can contain combinations of numerical
values (constants or variables), macros, mathematical and logical
operators, and logical statements.

**Force Unit**

A Force Unit is a group of individuals, defined by jobs, who perform a
variety of activities according to schedules.

**Function**

A network that is inside another network. In a model, all networks are
functions except for the top network (level 1). You can create a function by
dragging a function object to the Network Diagram from the Palette. Select
the function with the pointer to open its diagram. Function diagram are
drawn in the same way as the main network diagram. Functions usually
also contains tasks.
**Function Criterion**
Function Criterion is a percentage that determines how often the function must meet its Function Time Requirement to be considered a success. Enter a value between 0 and 100, inclusive.

**Function Time Requirement**
The Time Requirement is the slowest performance time that can be tolerated and have the function still be considered a success. When IMPRINT Pro executes your mission model, the performance time that is predicted by the aggregation of all tasks in this function will be compared to this standard to ensure that your design can meet the function level time requirement. The format for this entry (as with all other time values) is HH:MM:SS.mm. To enter a time requirement of 30 minutes, 15 seconds enter 00:30:15.00. Notice that you can enter hundredths of a second after the decimal point.

**Job**
The occupation held by one or more members of the Force Unit. Each job is defined by a name, specialty, rank and role. Examples may include Tank Driver, Navigator and Analyst.

**Length of run**
The number of days of operations that the IMPRINT Pro maintenance model will simulate. If you define mission segments for more days than are entered here, the model will not execute any segments that go beyond this value. This value defaults to 1.00.
**Macro**

One or more mathematical or logical expressions that are assigned a single name and return a single value. When a macro name is encountered in an expression in a model, the model executes the expressions included in the macro and returns a value. IMPRINT Pro contains model, mathematical, and distribution macros for your use, or you can define and save your own macros with the model.

**Maximum Number of Systems**

This value is the maximum number of systems that would be assigned to your segment if available.

**Mean Accuracy**

The Mean Accuracy is the estimate of the most likely, or average, accuracy value for a task.

**Mean Time Expression**

The Mean Time represents the average number of seconds required to execute a task. You can either enter a mean time value (00:00:30) or you can enter an expression\(\text{clock} \leq 30 \) then 10 else 15\). Each expression is delimited by semicolons. In building the expression you can use any of the algebraic or logical operators including the following: \((&, |, >, <, : =, ==, +, -, *, \text{ and } /)\), and you can use if-then-else statements. The assignment operator is :=. The equivalence operator is ==.

**Minimum Number of Systems**

This value is the minimum number of systems that must be ready to begin the segment prior to the cancellation time in order to prevent all departure groups from being canceled.

**Mission Accuracy Criterion**

The Mission Accuracy Criterion is a percentage that determines how often the mission must complete without abort to be considered a success. Aborts are caused when a task fails and the consequence of failure is mission abort. Values can range from 0 to 100.

**Mission Criterion**

The Mission Criterion is the percentage that represents how often the mission must meet both its time and accuracy standards at the same time. Values can range from 0 to 100.
**Mission Description**
The Mission Description is a fairly long text field that you can use to describe the mission you intend to model. The description is limited to 255 characters. All printable text characters are allowed.

**Mission Name**
The Mission Name is a brief text label that you will use to uniquely identify your system's mission. The mission name is limited to 60 characters. All printable text characters are allowed, including spaces.

**Mission Time Criterion**
The Mission Time Criterion is a percentage that determines how often the mission must meet its Mission Time Requirement to be considered a success. Values can range from 0 to 100.

**Mission Time Requirement**
The Time Requirement is the slowest performance time that can be tolerated and have the mission still be considered a success. When IMPRINT Pro executes your mission model, the performance time that is predicted by aggregating your individual tasks will be compared to this standard to ensure that your design can meet the mission level time standard. The format for this entry (as with all other time values) is HH:MM:SS.mm. So, to enter a time requirement of 30 minutes, 15 seconds enter 00:30:15.00. Notice that you can enter hundredths of a second after the decimal point.

**MMH/System**
Annual MMHs/system (ORG, DS, & GS levels) are the total number of annual maintenance manhour (by maintenance level) required to maintain one new system in that unit.

**New Systems**
This is the number of new systems that will be fielded in the unit.

**Network**
A sequential relationship of jobs (tasks and functions) that simulate a system, activity, or process. You create the network by drawing a network diagram, and you use variables to simulate the effects of the tasks on other tasks and on the system.
**Network Diagram**

A graphical depiction of a model network showing the sequence of tasks and functions, and the possible paths through the network. You draw the network diagram using the objects on the Palette.

**Number of times to run the mission**

If you would like to run a model more than once, you can enter that number in this field. If you have a relatively short scenario (in days), you may want to run the model several times in order to be confident that the data you get from all of the runs is representative. One short run may, by chance, produce data that are not very typical. Running a model for a long period of time (for example, 90 days) will also improve the probability that the results are typical. IMPRINT Pro will automatically begin each run with a new random number seed. This value defaults to 1.

**Number Per Departure Group**

This value controls the number of systems per group (sometimes referred to as a “flag”) that are sent out on this segment.

**OP Tempo**

Annual OP Tempo is the usage per year that the new system is expected to accrue in the type and size unit listed.

**Overall Workload**

The sum of all single task demand values and all conflict values (inter-channel and intra-channel) of all ongoing tasks that an operator is currently performing at a given instant of time (see Operator Workload Summary and Detail reports.)

**Path**

A sequential connection between two nodes (tasks or functions), drawn by dragging the mouse cursor from one node (source) to another (destination). The conditions under which the path is taken is specified in the Paths tab of the source node.
**Planned Activity**

A planned activity is an activity comprising part of a Force Unit schedule, which has a designated start time and will last until the next scheduled activity is set to occur. Examples may include “guard duty,” “hygiene,” “eating” and “sleeping.”

**Primary Operator**

The Primary Operator is the specialty and crew position that will be assigned to perform the task.

**Probability of Success**

The Probability of Success is the likelihood that a task will succeed each time it is executed. This number can either be manually entered or can be calculated as a result of entering values for the remaining three fields upon which it is dependent, namely the Mean Accuracy, Accuracy Standard Deviation and the Accuracy Requirement.

\[ Q \]

\[ R \]

**Random Number Seed**

A number between approximately -2 billion and +2 billion used to generate random numbers for calculating task execution times and taking probabilistic paths through the network. You supply the random number seed when you define the Execution settings for a model.

**Rank**

An official position or standing in the armed forces. This information is used to help define the jobs in a force unit. Ranks include E1-E3 (Private and Private First Class), E4 (Specialist or Corporal), E5 (Sergeant), E6 (Staff Sergeant), E7 (Sergeant First Class), and E8-E9 (Master Sergeant, First Sergeant, Sergeant Major, Command Sergeant Major and Sergeant Major of the Army).

**Release Condition**

An expression that is evaluated to determine whether or not a task can execute. A task can execute only when the value of the release condition is nonzero or true. You supply the release condition when you define the task. The default release condition is always “true”.
Repeating Segments
A Repeating Segment is one in which IMPRINT Pro’s maintenance model will attempt to send more systems out to perform this segment every so often. You can identify the frequency of the segment (for example, “repeats every four hours”).

Replacement Systems
The number of old systems that will be replaced in a unit.

Resource-Interface Channels
Resource-Interface Channels are formed by pairing the human resources with the interfaces (for example, visual/heads up display, motor/control stick). All workload is assigned to a task by setting individual single task demand values for each resource-interface channel used to perform that task.

Role
The level of participation that a job (an occupation held by one or more members of the Force Unit, such as a driver or gunner) will have in an unplanned activity if one requiring such a level occurs. Roles include Leader, Sub-Leader and Member.

Run number
The current run number in cases where there are multiple runs. The run number can be accessed through the expression `Model.RunNumber`.

Scenario Description
The scenario description is a free text field that you can use to document your analysis. It is limited to 255 characters.

Scenario Name
This is the name of your maintenance scenario. You can have many maintenance scenarios for each system.

Seed
A random number seed used to run a model. The random number seed generates a set of random numbers that are used to calculate task execution times and probabilistic paths taken through the network. The random number seed can be set in the Execution dialog box. For multiple runs of a model, the variable `Model.RandomSeed` contains the random seed used to generate the particular run.
**Segment Cancellation Time**

This is the number of hours that the simulation will wait for the minimum number of systems to be available before canceling the segment. For example, if the minimum number of systems for this segment is six and there are only four available at the scheduled start of the segment then the segment must wait. If there is a value of “01:00:00.00” in this field, then if the minimum number of systems do not become available within one hour of the scheduled start, the segment will be canceled. The default value for this item is 00:00:00.00. This means that the minimum number of systems must be available at the start time of this segment in order for the segment to begin. Be very careful that your cancellation is not after the segment would be attempting to repeat.

**Segment Duration Time**

This value indicates the number of operational hours for this segment. This value is used to schedule the return of the systems from operations and the beginning of the maintenance window. Additionally, this time is used to determine usage for the equipment on which failures are triggered by time.

**Segment Priority**

When more than one segment has been defined to occur at the same time, the segments must compete for available systems. In this box, you can enter a priority number for each segment. Available systems will be allocated to higher priority segments first.

**Segment Repeat Mean Time**

If you have checked the Repeating box for your segment, you will be able to enter a time in the Segment Repeat Time box. The value in this box controls the frequency (in hours) with which the simulation will attempt to repeat this segment. If you will enter the number 4 in this box, it will indicate that you want this segment to repeat every four hours. In other words, this segment will try to start again every four hours throughout the simulation. If you wanted this segment to repeat only twice, you could do this by defining two separate but identical segments with one starting four hours after the first.

**Segment Start Day**

The Segment Start Day and the Segment Start time work together to identify the start time of this segment. This value defaults to 1. If you were to leave the default values in both of these boxes, this mission would begin at time 0 on day 1.
**Segment Start Time**
The time entered in the Segment Start Time box indicates the time the segment is to begin. This value defaults to 00:00:00.00.

**Shift Data**
Enter the maintenance shift length in clock hours and the number of shifts per day. The product of the two numbers must be less than or equal to 24. The number of shifts will determine the number of shift columns in the Maintenance Crew spreadsheet.

**Shift Length**
The length of shift in hours.

**Shifts per day**
The number of shifts per day.

**Snapshot**
An option that records the values of specified variables at particular points during model execution—for example, when a task starts or ends, at the end of a run, or at specific clock times. When you run a model for which you have defined snapshots, the values are recorded, and results may be viewed in the Snapshots report.

**Specialty**
A specialty is a designation for a particular military job within the Armed Forces referenced by a 3-letter designation. For example, a Scout helicopter repairer is designated 67S. This option enables you to select people of appropriate specialties for task assignments.

**Spinner Task**
A task with a path that goes back to itself. Spinner tasks are used to generate multiple entities to travel through the network.

**Subsystem Equipment Group Name**
The subsystem type indicates the operational units (Armament, Mobility, and Other) that are used to describe the usage for that subsystem.
Subsystem
A subsystem is one of several smaller elements comprising a system, for example, an engine is a subsystem that is part of a system called “Tank”. Each Subsystem is going to be one of three types (Armament, Mobility, and Other) and must be uniquely named. Subsystem type indicates the operational units that are used to accrue the usage for that subsystem. Usage for an Armament subsystem is described as the number of rounds that have been fired from that subsystem. Usage for components in a Mobility system is described in terms of the distance that the system has traveled. Subsystems with a type of “Other” use operational time as the usage measure.

Task
Tasks are the basic building blocks of a model. A task is defined by timing information, execution constraints (or release conditions), effects of the task on the system, and routing information concerning following tasks and functions. Each time a task executes, the execution time is randomly calculated within the time distribution parameters you supply. You can create a task using the Palette and Network Diagram or through the Analysis Tree. To define a task simply double-click the task in the tree or in the network, and enter its information in the Task Properties window.

Task Accuracy Probability
As an alternative to specifying a task's Accuracy Mean, Standard Deviation and Accuracy Standard data and relying upon IMPRINT Pro to calculate its Probability of Success, you can instead directly enter this value by (as a percentage) in the Probability of Success field. When the task runs, the value entered here is compared with a random number to determine if the task was performed accurately.

Task Criterion
The percentage of time that the task must meet its time and accuracy standards in the same simulated occurrence in order to considered a success.

Task Mean Accuracy
The average value for how accurately a particular task is likely to be performed.
**Task Name**
This text box displays the name of the task for which you are displaying or entering information.

**Task Priority**
On the Effects tab, task priorities are used to execute priority-based workload management strategies. The priorities range from 1 (very low) to 5 (very high). New tasks are assigned a priority level of 3 (medium). To change a priority level for a task, double-click on a task to open the task parameter window, click in the Task priority field of the task and enter a priority value between 1 and 5, or click on the drop box in the task priority field and select a priority from the list.

**Task Standard Deviation**
A measure that tells you how closely all the various task times calculated by IMPRINT Pro are clustered around the mean task time. In general, one standard deviation away from the task mean time in either direction (greater than or less than the mean) accounts for somewhere around 68 percent of all computed task times. Two standard deviations away from the mean account for roughly 95 percent of the computed task times. And three standard deviations account for about 99 percent of the computed task times. By specifying the Task Standard Deviation for your task, you are helping IMPRINT Pro to determine how widely varied (or unvaried) the distribution of all your different calculated task times will be.

**Task Time Requirement**
The Time Requirement is the slowest performance time that can be tolerated and have the task still be considered a success. When IMPRINT Pro executes your mission model, the Distribution along with parameters Mean and Standard Deviation are used to choose a specific task time for each occurrence of each task. These times are then accumulated throughout the model run and compared to the time standard in order to report the percentage of successes for each task. To enter the time requirement, use the mouse to position the cursor in the time requirement box.

**Time Between Departures**
The value in the Time Between Departures field denotes the amount of time that must lapse between any two consecutive group departures for a given segment. This value is in hours and can be entered in the HH:MM:SS.mm format to include hundredths of hours.
**Time Format**

Time data entered in the IMPRINT Pro interfaces or viewed in the IMPRINT Pro reports can be displayed in one of several different formats, such as hours, minutes, seconds and HH:MM:SS.mm. Time formats may be changed in the Time tab through the Preferences option under the View menu.

**Time Requirement**

The Time Requirement is the maximum acceptable performance time for a task.

**Unplanned Activity**

A unplanned activity is an activity which can interrupt the normal planned activities comprising a Force Unit schedule. Unplanned activities are defined by a probable start time, duration and the number of people required to address them. Examples may include “fire” and “emergency”.

**Variable**

An identifier which is used to represent a quantity which can vary in value. When a variable name is encountered in an expression, IMPRINT Pro substitutes in the current value of the variable and evaluates the expression. Variables are useful for representing changeable aspects of the system you are simulating. You can change the value of a variable through any expression in your model, for example, in a task effect or in a scenario event. For each IMPRINT Pro model, five system variables are automatically created including Clock, Distributions, Entity, Model, and Task. For more information about system variables see the “Variables” section in this manual.

**Warfighter**

A warfighter is any person or automated device that operates, maintains, supplies or supports military equipment.